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INC.
NIC DIVISION

ISSUE 2
FEBRUARY 15, 1985

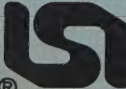
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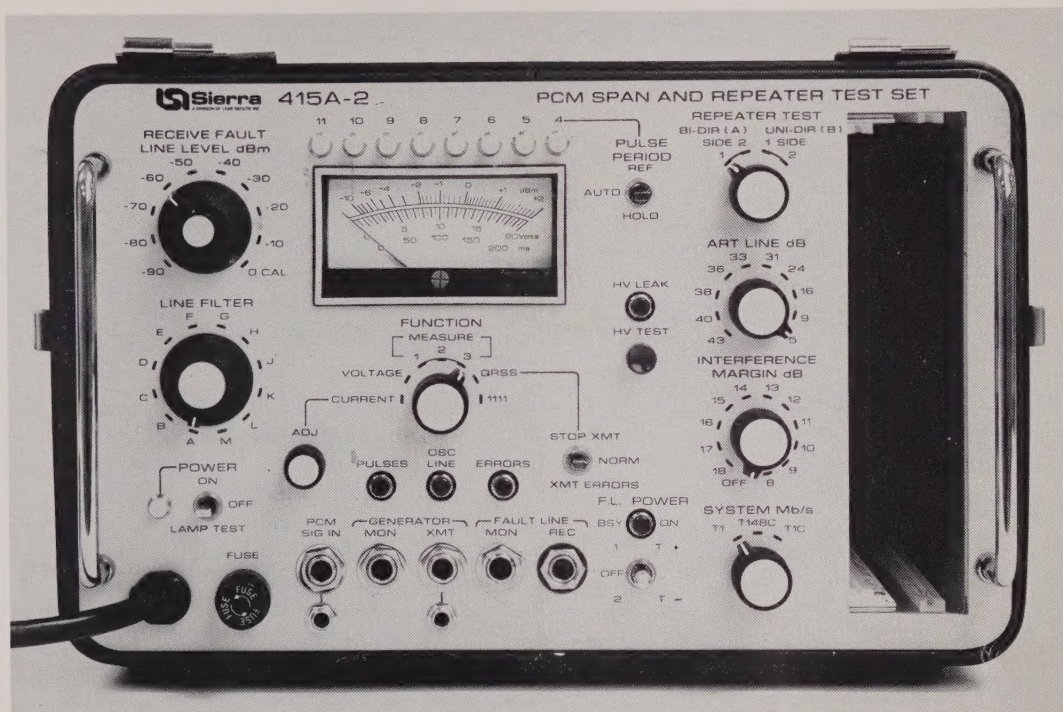
Sierra 415A-2

PCM SPAN AND REPEATER TEST SET

MAINTENANCE MANUAL

B025415A2B

 **Sierra**
A DIVISION OF LEAR SIEGLER, INC.



LSI/Sierra 415A-2 PCM Span and Repeater Test Set

This Maintenance Manual provides information for service and calibration center use. It is suggested that the instrument be calibrated on an annual basis, depending upon conditions and user requirements.

NOTE:

This manual reflects the current production of the 415A-2, beginning with Serial Number 1754. Earlier production units did not have a fuseholder or a Fault Line Power indicator and toggle switch on the front panel.

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1. FUNCTIONAL DESCRIPTION

- 1.01 The 415A-2 consists of a pattern generator, counter logic control, receiver, error detector, repeater tester, and power supply.

PATTERN GENERATOR

- 1.02 The pattern generator provides MEAS 1, MEAS 2, and MEAS 3, Quasi-Random Word, and "All Ones" signals. It includes various clock oscillators, pulse power output stage, and certain logic controls.
- 1.03 Crystal-controlled Clock Oscillators set the basic transmission speed of all generated test patterns. They are controlled by the SYSTEM Mb/s switch. Three line bit rates may be selected by the control: 1.544 Mb/s (T1), 2.364 Mb/s (T148C) and 3.152 Mb/s (T1C). The clock circuit generates a succession of precisely divided "time slots" into the Pattern Generator and its associated format-determining input circuits.
- 1.04 The standard Quasi-Random Word (QRW) is connected to the Pattern Generator when the FUNCTION switch is positioned to QRSS ("Quasi-Random Signal Source"). It is a repetitive sequence of 1,048,575 bits. QRW simulates an active PCM terminal by generating a similar spectrum of energy. The signal is limited to a maximum of 14 digital zeros in sequence to correspond with current system design practice. (Good repeaters can generally tolerate 14 zeros in sequence, i.e., no pulses during 14 time slots, while marginal repeaters may fail because their resonant input circuits tend to fall out of step during lengthy absence of pulses.)
- 1.05 At 1.544 and 3.152 Mb/s rates QRW is produced by a 20-bit shift register and associated gate circuits ("2²⁰ -1" bit count). At the 2.364 Mb/s rate the clock drives a special "4B3T" (Four Binary to Three Ternary) encoder to accommodate specific line coding of the T148C-type PCM system.
- NOTE: Bipolar line signals found in T1, T1C, etc. systems are referred to as AMI (Alternate Mark Inversion). Each pulse is followed by a pulse of the *opposite* polarity. By contrast, 4B3T is a special coding technique which includes frequent violations of the AMI principle.
- 1.06 When the FUNCTION switch is positioned to MEASURE 1, 2, or 3 the pattern generator is conditioned to produce special groups of bipolar pulses which vary at an audio rate selected by the LINE FILTER switch. When the FUNCTION switch is positioned to "1111" the pattern generator produces all "ones", that is, every time slot will be occupied by a pulse.
- 1.07 Output of the Pattern Generator drives the Output Amplifier, which produces a line signal of 6V peak-to-peak (3V base-to-peak). This pulse amplifier generates a pulse only when commanded by the Pattern Generator. Polarity of the pulse is also determined by the Pattern Generator.
- 1.08 A switch associated with the QRSS function can initiate pre-determined bipolar violations (T1, T1C only) into the Pattern Generator (XMT ERRORS) or turn off the output amplifier to momentarily stop transmission of signals (STOP XMT).
- 1.09 In the MEASURE 1, 2 and 3 positions the Pattern Generator can be controlled by the Counter/Logic circuit, which determines the density of pulses in the test signals. The PULSE PERIOD switch determines whether density will be lightest (REF position), or allowed to progress periodically toward greater density (AUTO), or to hold at a specific density (HOLD).

RECEIVER

1.10 The Receiver circuit includes input amplifiers and bandpass filters to process the incoming tone signal from the Fault Locating Pair. The RECEIVE FAULT LINE LEVEL control adjusts the gain of the receiver. A section of the LINE FILTER switch selects correct high and low pass filter components to provide a narrow audio bandpass at the desired frequency.

1.11 The received tone is fed into a Correlator which is conditioned to recognize the desired audio tone established by the LINE FILTER control. Output of this synchronous detector is a DC potential which varies according to the level of the received tone. Output of the Correlator drives the Meter. The correlator is essentially a finely tuned tracking bandpass filter (band-width about 20 Hz). It is capable of maintaining the narrow pass band without need for manual tuning circuits.

ERROR DETECTOR

1.12 The error detector includes all error, pulse and oscillating line detecting circuitry. The *Pulses* detector recognizes line signals and lights the PULSES lamp.

1.13 When the SYSTEM Mb/s switch is positioned at either T1, or T1C, the *AMI Errors* Detector is operative. Any violation of the alternate mark inversion rule will activate the detector and light the ERRORS lamp.

1.14 When the SYSTEM Mb/s switch is positioned to T148C, the *4B3T Errors* Detector is operative. It is designed to ignore the coded bipolar violations and light the ERRORS lamp only when violations are received out of the expected pattern.

1.15 The *Oscillating Line* Detector lights the OSC LINE lamp when it detects frequencies less than 100 kHz at the PCM SIG IN jack.

REPEATER TESTER

1.16 The Repeater Tester includes circuits for input/output interface with an inserted repeater. Components of the tester include a signal generator, an interference generator, an artificial line, and repeater voltage, current and insulation resistance test circuits.

1.17 The *Artificial Line* provides simulated characteristics of a line for testing an inserted repeater. Attenuation is varied by the ART LINE dB switch, from 5 to 43 dB loss at 772 kHz. When the GEN XMT and PCM SIG IN jacks are unoccupied the Generator signal is fed into the artificial line, and the Error Detector circuits monitor the repeater output.

1.18 *Interference* is simulated by a sine wave signal at a frequency close to one-half the bit rate selected by the SYSTEM Mb/s switch. When interference is increased (clockwise direction of the INTERFERENCE MARGIN switch) the simulated crosstalk energy should eventually cause errors at the repeater output, as indicated by a flashing ERRORS lamp. Designations on the INTERFERENCE MARGIN switch (18 through 8) are generally related to signal-to-noise ratio readings. Switch readings were calibrated on the basis of an "all ones" signal (FUNCTION switch to 1111) and 31 dB attenuation (ART LINE to 31).

POWER SUPPLY

1.19 The power supply includes regulated +5V for logic circuits, +15V and -15V for other circuits, and -200V for repeater insulation resistance testing. To test *Insulation Resistance* the HV TEST pushbutton is depressed. If less than 1 Megohm $\pm 50\%$, the HV LEAK lamp will light.

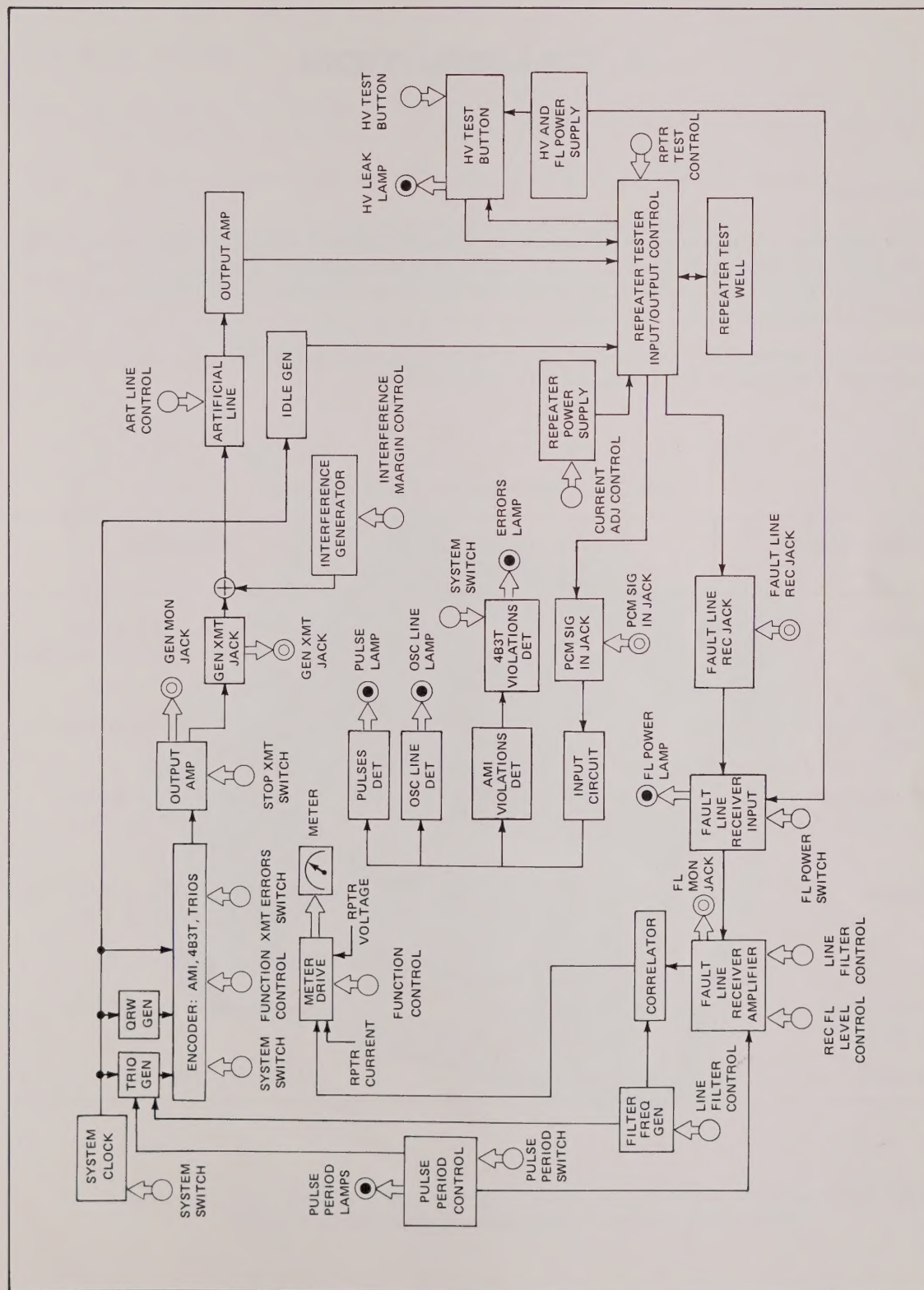


Figure 1-1. Functional Block Diagram

2. CALIBRATION

INTRODUCTION

2.01 The following calibration procedure applies to recently produced 415A-2 test sets, which will test T1, T1C, and 2.364 Mb/s T148C systems. Older units were designed to test T1, T1C, and 2.37 Mb/s T148 systems. When using this procedure on one of the older test sets, all references to 2.364 (T148C) should be read as 2.37 (T148).

Test equipment recommended for calibration of the Sierra 415A-2 is listed in Table 2-1. Alternatively, other equipment with equal or better characteristics may be used.

Table 2-1. Recommended Test Equipment

DESCRIPTION	MODEL OR PART DESIGNATION	COMMENT
Oscilloscope	Tektronix 7603	Dual trace A + B function, 50 MHz bandwidth or greater, X 10 probes
Digital Multimeter (DMM)	Dana 3300, 4300 or Fluke 8000A	1 Megohm input or greater, 1% accuracy
RMS Voltmeter	Fluke 8920	1 Megohm input or greater, 800 Hz to 3100 Hz, linear dB scale
Synthesizer	Fluke 6011A or Rockland 5100	800 Hz to 4 MHz, 500 mV to 5V, 1% distortion or less
Counter	Fluke 1900A	2 MHz or greater
Extender Board (Basic PCB)	Sierra 904500719	See Paragraph 2.03, Step 5
Test Cord	Sierra 916400037	310 to 310 plug

INTERNAL ACCESS

2.02 For access to internal parts of the 415A-2 and to various test points on PCB's, remove the instrument from its metal case as follows: (Figure 2-1 shows PC board and fuse location.)

- Step 1: Remove case carrying cover and verify POWER switch is in OFF position.
- Step 2: Place test set face down resting firmly on its chromeplated bails.
- Step 3: Loosen captive, quarter-turn fasteners at each of four corners on test set's backside.
- Step 4: Lift metal case vertically until it clears instrument.

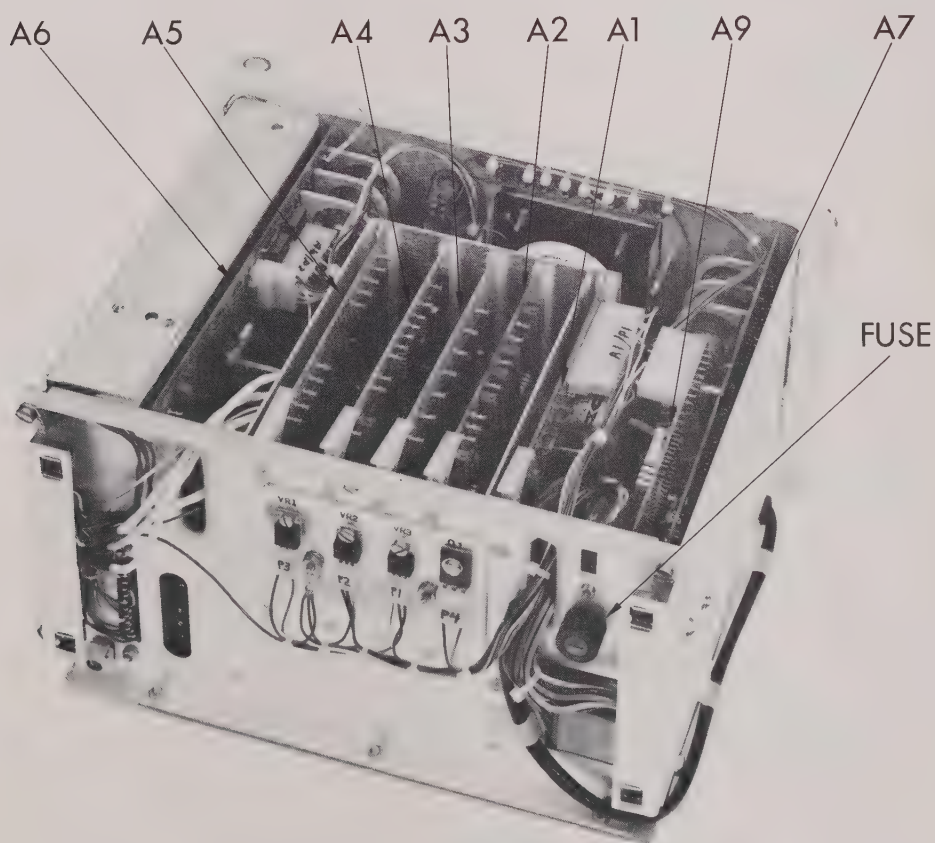


Figure 2-1. Rear View of Chassis of 415A-2 Showing Location of PC Boards and Fuse.
(Beginning with Serial Number 1754, Fuse is on Front Panel)

POWER SUPPLY

2.03 Before beginning the calibration procedure, permit all test equipment to warm up for a minimum of 30 minutes. Adjust 415A-2 meter to mechanical zero to minimize error in the horizontal and vertical positions.

WARNING

WHEN TEST SET IS REMOVED FROM CASE AND POWERED ON, POTENTIALLY HAZARDOUS VOLTAGES ARE PRESENT: THEREFORE, APPROPRIATE SAFETY PRECAUTIONS MUST BE PRACTICED AT ALL TIMES WHILE WORKING ON OR AROUND EXPOSED CIRCUITS AND CONNECTORS.

Power Supply Regulation

- Step 1: Set 415A-2 instrument power toggle switch to POWER ON (UP). Verify POWER lamp is illuminated.
- Step 2: Using DMM, verify $+5.0 \pm 0.3$ VDC from TP3 of A1 PC board to 415A-2 chassis.
- Step 3: Using DMM, verify $+15 \pm 0.5$ VDC from TP1 of A1 PC board to 415A-2 chassis.
- Step 4: Using DMM, verify -15 ± 0.5 VDC from TP2 of A1 PC board to 415A-2 chassis.

Power Loop Current and Voltage

- Step 5: Using the basic PCB and the listed components, construct the Extender Board according to Figure 2-2. Three variable items should also be available:
 - (1) **Movable 750k Ohm Resistor.** Connect alligator clips to the ends of the 750k Ohm resistor.
 - (2) **Movable Short.** Connect alligator clips to the ends of a piece of wire to provide a movable short.
 - (3) **Movable Meter (DMM).** Use alligator clips or other movable contacts on the Digital Multimeter.
- Step 6: Plug Extender Board into repeater test receptacle insert. Connect movable short across E3 and E4. Connect DMM across E2 and E3 with polarity as shown in Figure 2-2.
- Step 7: Set 415A-2 FUNCTION selector control switch to CURRENT and rotate current ADJ pot 415A-2 front panel for DMM indication of 15.00 VDC.
- Step 8: Adjust potentiometer R10 of A1 PC board for indication of 200 mA on 415A-2 meter.
- Step 9: Set 415A-2 FUNCTION selector control switch to VOLTAGE, rotate current ADJ pot for DMM indication of 10.50 VDC.
- Step 10: Adjust A1R27 for 415A-2 meter indication of 10.5 VDC. ←
- Step 11: Set 415A-2 selector control switch to CURRENT and vary ADJ pot until 415A-2 meter current range span of 20 mA through 200 mA is confirmed.

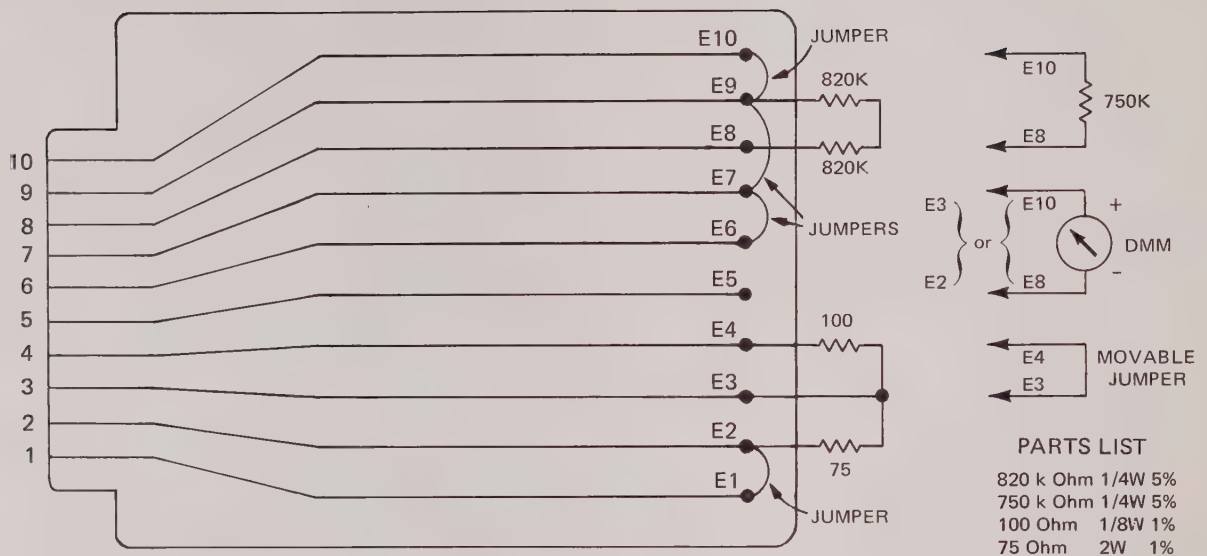


Figure 2-2. Extender Board Configuration

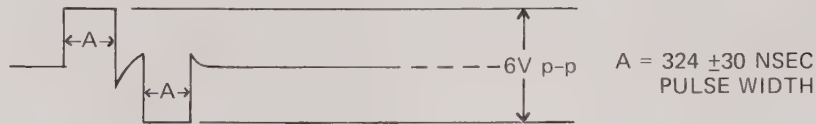
TRANSMITTER

2.04 Initial transmitter tests are made on the generator. Artificial line length simulator calibration and interference margin tests are done after the receiver calibration is complete.

Generator

- Step 1: Set appropriate 415A-2 selector control or toggle switch as described in (a) through (d).
- PULSE PERIOD to REF
 - FUNCTION to 1111
 - STOP XMT/NORM/XMT ERRORS to NORM
 - SYSTEM Mb/s to 1.544 (T1)
- Step 2: Connect 310 plug with 100-ohm, 1/4 Watt, 1% resistor across Tip and Ring to GEN XMT jack.
- Step 3: Connect oscilloscope probes across 100-ohm resistor with both probe ground leads connected to chassis ground.
- Step 4: Set oscilloscope controls as listed in (a) through (e).
- SYNC to INTERNAL
 - MODE to A + B (Added)
 - CHAN B to INVERTED
 - SENSITIVITY to 0.1 v/cm (x 10 probes) (CH A & B)
 - SENSITIVITY to 1 v/cm (x 1 probes) (CH A & B)

Step 5: Adjust oscilloscope sweep rate so that bipolar pulse pattern is present. Verify that pattern is 6.0 ± 0.5 V p-p. If not, adjust R46 on A4 PC board for 6.0 V p-p.



Step 6: Set 415A-2 SYSTEM Mb/s selector control switch to 2.364 (T148C) and verify 6.0V p-p bipolar pulse pattern with pulse width of 212 ± 20 nanoseconds on oscilloscope.

Step 7: Set 415A-2 SYSTEM Mb/s selector control switch to 3.152 (T1C) and verify 6.0 V p-p bipolar pulse pattern with pulse width of 159 ± 25 nanoseconds on oscilloscope.

Step 8: Set 415A-2 FUNCTION selector control switch to MEASURE 1 and SYSTEM Mb/s selector control switch to 1.544 (T1). Verify that a series of pulse TRIOS are present. (Refer to Figure 2-3. It may be necessary to readjust oscilloscope sweep rate.)

Step 9: Set PULSE PERIOD toggle switch to AUTO and Verify pulse TRIOS increase in density by 648 nanoseconds for each pulse period.

Step 10: Return PULSE PERIOD toggle switch to REF and remove 310 plug from GEN XMT jack.

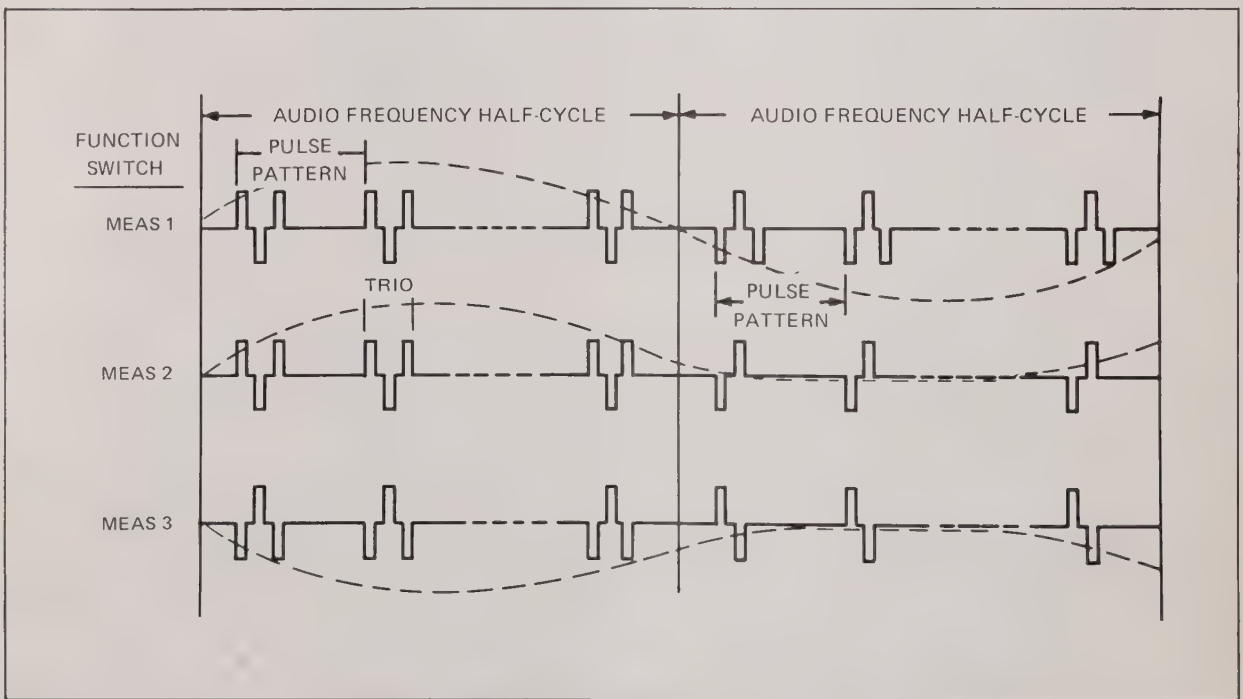


Figure 2-3. Transmitter Pulse Pattern

ERROR DETECTOR

2.05 Error detector tests include the oscillating line and drive level.

Oscillating Line

- Step 1: Connect frequency synthesizer to PCM SIG IN jack and monitor input level with one channel of oscilloscope.
- Step 2: Adjust frequency synthesizer for 50 kHz at 3.5 V p-p. Verify that 415A-2 OSC LINE indicator lamp illuminates.

Drive Level

- Step 3: Adjust frequency synthesizer for 772 kHz at 8.0 V p-p.
- Step 4: Verify that 415A-2 PULSES indicator lamp is illuminated while OSC LINE and ERRORS indicator lamps remain extinguished.
- Step 5: Adjust frequency synthesizer for 772 kHz at 2.0 V p-p.
- Step 6: Verify that PULSES indicator lamp is illuminated while OSC LINE and ERRORS indicator lamps remain extinguished.

RECEIVER

2.06 The receiver tests consist of verifying line filter frequencies and making correlator adjustments.

Line Filter Frequencies

- Step 1: Connect frequency counter to 415A-2 between TP1 of A2 PC board and GND.
- Step 2: Verify that each line filter frequency listed in Table 2-3 corresponds to appropriate LINE FILTER switch setting. Adjust R137 on A7 PCB as required, so all frequencies are within specified tolerances. (R137 is located on bottom side of unit near front panel.)

Correlator

- Step 3: Connect frequency synthesizer via electrolytic 15-microfarad 20 Volt (approximate) capacitor to 415A-2 TP2 of A2 PCB. Set frequency synthesizer to 1 kHz and +20 dB.
- Step 4: Connect oscilloscope to 415A-2 via TP3 of A2 PCB. Adjust R11 of A2 PCB until waveform on scope is exactly uniform in peak-to-peak amplitude (positive and negative symmetry). Slight adjustment of R15 may also be necessary.

Table 2-3. Setting and Frequency

LINE FILTER SETTING	LINE FILTER FREQUENCY
A	832 $\pm$ 17 Hz
B	928 $\pm$ 19 Hz
C	1048 $\pm$ 21 Hz
D	1206 $\pm$ 24 Hz
E	1340 $\pm$ 27 Hz
F	1508 $\pm$ 30 Hz
G	1722 $\pm$ 34 Hz
H	2008 $\pm$ 40 Hz
J	2193 $\pm$ 44 Hz
K	2413 $\pm$ 48 Hz
L	2680 $\pm$ 54 Hz
M	3017 $\pm$ 60 Hz

- Step 5: After moving synthesizer connection (via decoupling cap) to TP5 and oscilloscope connection to TP6 of A2 PC board, repeat Steps 1 and 2. Adjust R35 on A2 PCB for same waveform uniformity prescribed in Step 2. Slight adjustment of R39 may also be necessary.
- Step 6: Disconnect synthesizer and oscilloscope from 415A-2. Connect digital multimeter (DMM) to 415A-2 between TP7 and positive end of C10 on A2 PCB. Adjust R19 on A2 PCB for 0 ± 0.002 VDC. Disconnect DMM from 415A-2.
- Step 7: Set appropriate 415A-2 selector control or toggle switch as described in (a) through (e).
- RECEIVE FAULT LINE LEVEL dBm to 0 CAL
 - ADJ Vernier control fully clockwise
 - LINE FILTER to C
 - PULSE PERIOD to REF
 - FUNCTION to MEASURE 1
- Step 8: Monitor frequency at TP1 of A2 PCB on counter.
- Step 9: Connect frequency synthesizer to FAULT LINE REC jack using RMS voltmeter to monitor input level.
- Step 10: Adjust synthesizer for same frequency indicated on counter. Adjust synthesizer input level for 948 mv as indicated on voltmeter.
- Step 11: Verify that 415A-2 meter indicates 0 dB. Adjust R23 potentiometer on PC board A2 as required for 0 dB indication.

R15 Adjust from left to Zero
R39 Adjust from RT. to Zero

SIERRA 415A-2

Step 12: If 415A-2 meter indicates drift in excess of ± 0.2 dB, alternately adjust R15 and R39 on PCB A2, as required, to minimize drift. Readjust R23, as required, for 415A-2 meter indication of 0 dB.

NOTE: It may be necessary to slightly adjust the synthesizer frequency to obtain the desired drift "beat" frequency and median level 415A-2 meter "peaking" indications. Once "peaking" is established, the adjustment should be within a nominal variation of ± 1 Hz.

ARTIFICIAL LINE

2.07 Artificial line length simulator calibration is a continuation of the transmitter calibration.

Step 1: Disconnect movable items from Extender Board. Connect RMS Voltmeter across E3 and E4.

Step 2: Set appropriate 415A-2 selector control or toggle switch as described in (a) through (f).

- a. PULSE PERIOD to REF
- b. FUNCTION to 1111
- c. ~~REPEATER TEST to BI-DIR SIDE 1~~
- d. INTERFERENCE MARGIN dB to OFF
- e. ART LINE to 5
- f. SYSTEM Mb/s to 1.544 (T1)

Step 3: Verify that RMS voltmeter levels conform to values shown in Table 2-2 for corresponding art line settings. For optimum compromise of tabulated values, adjust potentiometer R124 on A6 PC board as required.

Table 2-2. Art Line Code

ART LINE SETTING	RMS VOLTMETER LEVEL
5	+2.8 ± 0.5 dB
9	-1.2 ± 0.5 dB
16	-8.2 ± 0.5 dB
24	-16.2 ± 0.5 dB
31	-23.2 ± 0.5 dB
33	-25.2 ± 0.5 dB
36	-28.2 ± 0.5 dB
38	-30.2 ± 0.5 dB
40	-32.2 ± 0.5 dB
43	-35.2 ± 0.5 dB

INTERFERENCE MARGIN

2.08 Interference margin tests are a continuation of the transmitter calibration.

- Step 1: Set 415A-2 ART LINE selector control switch to 24 and note exact reading in dB on voltmeter.
- Step 2: Set 415A-2 SYSTEM Mb/s selector control switch to 2.364 (T148C) and note exact reading in dB on voltmeter.
- Step 3: Set 415A-2 SYSTEM Mb/s selector control switch to 3.152 (T1C) and note exact reading in dB on voltmeter.
- Step 4: Set 415A-2 SYSTEM Mb/s selector control switch to 1.544 (T1) and set INTERFERENCE MARGIN selector control switch to 10.
- Step 5: Disconnect generator signal from ART LINE simulator by connecting 310 plug to GEN XMT jack.
- Step 6: Verify that voltmeter level reading is 10 dB below exact reading as noted in Step 1. If required, adjust potentiometer R98 on PC board A6. (For instance, if exact value is -16.2, then -10 dB of exact value will be -26.2 dB.)
- Step 7: Set 415A-2 SYSTEM Mb/s selector control switch to 2.364 (T148C) and verify that voltmeter level reading is 12 dB below exact reading noted in Step 2. If required, adjust potentiometer R99 on A6 PC board.
- Step 8: Set 415A-2 SYSTEM Mb/s selector control switch to 3.152 (T1C) and verify that voltmeter level reading is 12 dB below exact reading noted in Step 3. If required, adjust potentiometer R100 on PC board A6.
- Step 9: Set 415A-2 INTERFERENCE MARGIN selector control switch to OFF.

OTHER TESTS

- 2.09 Calibration is completed with three additional tests: performance of the high voltage leak test circuit; idle signal verification; performance of the fault line power test circuit.

High Voltage Leak

- Step 1: Connect DMM to terminals E8-GND and E10. (See Figure 2-2.)
- Step 2: Press REPEATER TEST/HV TEST pushbutton switch on 415A-2 and read digital voltmeter (CAUTION, HIGH VOLTAGE). Verify that voltage reading is within $\pm 10\%$ of -200 volts. Verify that the 415A-2 HV LEAK lamp remains extinguished.

- Step 3: Turn OFF 415A-2 and connect 750k resistor across pins E8 and E10 in parallel with the existing resistors.
- Step 4: Turn ON 415A-2 and press REPEATER TEST/HV pushbutton switch. Verify that HV LEAK lamp illuminates.

Idle Signal Verification

- Step 5: Disconnect RMS voltmeter from extender board and connect one channel of oscilloscope across 100-Ohm resistor E3 (GND) and E4 (Signal).
- Step 6: Set 415A-2 REPEATER TEST selector control switch to BI-DIR SIDE 2 and set SYSTEM Mb/s selector control switch to 1.544 (T1).
- Step 7: Verify that scope displays sinewave 340 ± 70 mv p-p.
- Step 8: Set 415A-2 SYSTEM Mb/s selector control switch to 2.364 (T148C) and verify that scope displays sinewave 250 ± 5 mv p-p.
- Step 9: Set 415A-2 SYSTEM Mb/s selector control switch to 3.152 (T1C) and verify that scope displays sinewave 130 ± 25 mv p-p.
- Step 10: Return 415A-2 SYSTEM Mb/s selector control switch to 1.544 (T1) position.
- Step 11: Remove extender board from repeater well and 310 plug from GEN XMT jack.

Fault Line Power

- Step 12: Turn the F. L. POWER (FAULT LINE POWER) switch OFF. Verify that the F. L. POWER indicator is **not** lit.
- Step 13: Connect the DMM to the FAULT LINE REC jack using a cord with a 310 plug. Connect plug so that tip goes to positive (+) lead of meter, and ring to negative (-). Connect the lead from the sleeve of the 310 plug to the chassis of the 415A-2 test set. (The sleeve on this jack is not connected internally to the test set chassis.)
- Step 14: Set F. L. POWER switch to +.
Verify that (1) the DMM reads $+117 \text{ V} \pm 12\text{V}$ and (2) the F. L. POWER indicator is lit.
- Step 15: Set F. L. POWER switch to -.
Verify that (1) the DMM reads $-117 \text{ V} \pm 12\text{V}$ and (2) the F. L. POWER indicator is lit.
- Step 16: Disconnect the lead from the sleeve of the 310 plug from the chassis of the 415A-2.
Verify that (1) the DMM reads 0 V and (2) the F. L. POWER indicator is **not** lit.
(A change takes about 3 seconds.)
- Step 17: Set the F. L. POWER switch to OFF.

CALIBRATION VERIFICATION

2.10 To insure that the test set is working correctly, you may wish to perform this optional operational test. It is suggested that this test be performed periodically. If results deviate significantly from anticipated results, servicing may be necessary.

Operational Test		
Step	Procedure	Result
1	Connect Power cord.	All front panel lamps light.
2	Momentarily depress POWER switch to LAMP TEST position.	
3	Set POWER switch to ON.	
4	Connect a patch cord from the GEN MON jack to the FAULT LINE REC jack.	
5	Set SYSTEM Mb/s to 1.544 (T1).	POWER lamp lights.
6	Set LINE FILTER switch to A.	
7	Set the PULSE PERIOD switch to REF.	
8	Set the FUNCTION switch to MEASURE 1.	
9	Adjust the RECEIVE FAULT LINE LEVEL control to -60, then adjust vernier control for a meter reading of 0 dB.	Lamp 11 lights.
10	Set the FUNCTION switch to MEASURE 2 position.	
11	Set the FUNCTION switch to the MEASURE 3 position.	
12	Reset the FUNCTION switch to the MEASURE 1 position.	
13	Switch PULSE PERIOD switch to AUTO.	PULSE PERIOD lamps light in sequence 11 through 4. Meter reading will rise with each step. Maximum increase is 2.2 dB for T1 and T148C, 2.5 dB for T1C, when lamp 4 is lit.
14	Reset PULSE PERIOD switch to REF.	
15	Rotate the LINE FILTER switch through all the settings, then return to A.	
16	Rotate the SYSTEM Mb/s switch to 2.364 (T148C) and 3.152 (T1C). In each position, repeat steps 9 through 14.	

Operational Test (continued)		
Step	Procedure	Result
17	Return the SYSTEM Mb/s switch to 1.544 (T1)	
18	Connect patch cord from GEN MON jack to PCM SIG IN jack.	
19	Rotate the FUNCTION switch through MEASURE 1, 2, and 3 positions.	PULSES and ERRORS lamps light.
20	Set FUNCTION switch to QRSS and toggle switch to NORM.	PULSES lamp lights; ERRORS lamp off.
21	Set toggle switch to XMT ERRORS.	ERRORS lamp flashes.
22	Set toggle switch to STOP XMT.	PULSES and ERRORS lamps go out.
23	Set FUNCTION switch to 1111 and toggle switch to NORM.	PULSES lamp lights; ERRORS lamp off.
24	Set toggle switch to XMT ERRORS.	ERRORS lamp flashes in T1 & T1C; does not flash in T148C.
25	Set toggle switch to STOP XMT.	PULSES and ERRORS lamps go out.
26	Reset toggle switch to NORM.	
27	Rotate the SYSTEM Mb/s switch through to 2.364 (T148C) and 3.152 (T1C). In each position, repeat steps 19 through 26	

3. TECHNICAL DATA

SPECIFICATIONS

3.01 Specifications are shown in Table 3-1.

Table 3-1. 415A-2 Specifications

PULSE TRANSMITTER

Bit Rate (switchable):	1.544 (T1), 2.364 (T148C), or 3.152 (T1C) Mb/s		
Time Slots:	1.544: 648 ns	2.364: 423 ns	3.152: 317 ns
Pulse Width, Nominal:	1.544: 324 ns	2.364: 212 ns	3.152: 159 ns
Pulse Rise or Fall Time:	1.544: 80 ns	2.364: 50 ns	3.152: 30 ns
Pulse Overshoot:	10 to 30% of pulse amplitude		
Pulse Amplitude:	$\pm 3V \pm 10\%$ base-to-peak ($6V \pm 10\%$ peak-to-peak)		
Audio Component	A 832	G 1722	
Frequencies (Hz):	B 928	H 2008	
	C 1048	J 2193	
	D 1206	K 2413	
	E 1340	L 2680	
	F 1508	M 3017	
Audio Component Accuracy:	$\pm 2\%$		
Interference Margin Signal:	Sine wave, level adjustable from 8 to 18 dB below level of all 1's signal at repeater input.		
	1.544 (T1):	770 kHz	
	2.364 (T148C):	1.179 MHz	
	3.152 (T1C):	1.570 MHz	

FAULT LINE RECEIVER

Filter Frequencies:	Same as transmitter audio component frequencies
Input Range:	-90 dBm to 0 dBm
Input S/N Requirement:	15 dB S/N minimum in a ± 10 Hz bandwidth centered on desired fault locating frequency.
Input Impedance:	900 ohms $\pm 10\%$
Level Reading Accuracy:	± 1.0 dB at 0 dBm on meter; ± 2.0 dB at -10 dBm on meter
Meter Accuracy:	$\pm 3\%$ of full scale
Common Mode Rejection:	60 dB minimum at 4 kHz
PCM Signal Input:	± 1.0 to ± 4.0 V, base-to-peak (2.0 to 8.0 V peak-to-peak)
High Voltage:	200 $\pm 10\%$ VDC. Lamp ON indicates less than 1 Megohm insulation resistance $\pm 50\%$.
Temperature Range:	Operating: 0 to $+50^\circ\text{C}$ Storage: -40 to $+65^\circ\text{C}$ Maximum Humidity: 95%
Power:	115/230 VAC $\pm 10\%$, 47.5 to 66 Hz
Dimensions, Nominal: (without cover)	Approximately 7.5 inches H x 12 inches W x 9.5 inches D
Weight	Approximately 15.5 pounds

ORDERING INFORMATION

- 3.02 The basic 415A-2 is mounted in a portable carrying case with a detachable cover. The optional inserts for local testing are shown in Table 3-2 and are ordered separately.

Table 3-2. Inserts and Accessories

INSERT PART NO.	APPLICATION
C02700502	Standard T1 (such as WEC0 201/205)
C02699001	Standard T1 (such as Vicom 1550-01)
C02979601	Mini T1 (such as WEC0 238/239)
C02979602	Mini T1 (such as WEC0 239E)
C03146900 246A-4	SLC 40 (such as WEC0 217A) & 3-ft Cable
C03147000	T1C (such as WEC0 248/249)
C03396700	T1C Bidirectional
C02776900	WEC0 206 Office Rptr
C03187700	WEC0 220 Office Rptr
D02986700	Lenkurt 91112 Office Rptr (w/48V cord)
C03187800	Lenkurt 91124/91141 Office Rptr
ACCESSORIES P/N	DESCRIPTION
913200033	Fuse, 115V: 1/4 A, slow blow, 250V
913200050	Fuse, 230V: 1/8 A, slow blow, 250V
913800060	Lamp, 5V, 20 mA incandescent, T1 Flange Base
921000075	Canvas Carrying Case
916400037	Test Cord, 6-ft. (310 to 310 plug)
243A-4	Test Cord, 6-ft. (310 to alligator clips)

4. SCHEMATICS AND PARTS LISTS

4.01 Section 4 includes the schematics and parts lists for each subassembly of the 415A-2 test set. The information applies to the instruments as produced in Sierra's factory at the date of this manual.

If this manual is being used for maintenance and repair on an instrument made at another time, the user must recognize that differences may exist between the manual information and the hardware.

Test set improvements have been made on a continuing basis since the instrument was first introduced. Generally, the information contained in this manual applies to all 415A-2 test sets.

When specific information does not appear to apply to the instrument under test, the user should call the Customer Service Department at the factory, giving the model number, serial number and date of purchase. The Sierra representative will provide the needed instructions and information to augment the material given in this section.

Description	Drawing Number
Interconnect Diagram	D03213900 (3 pages)
Circuit Boards:	
A1 Power Supply and Meter Drive	D03407700 (2 pages)
A2 Correlator	D03197700 (1 page)
A3 Error Detector	D03197800 (2 pages)
A4 Pattern Generator, Output Driver	D03197900 (2 pages)
A5 QRW and 4B3T Generator	D03198000 (2 pages)
A6 Repeater Tester	D03198200 (2 pages)
A7 Receiver	D03408300 (2 pages)
A8 Mother Board	D03407900 (1 page)
A9 Pulse Period Gain Comp, Lamp Driver	D03198600 (1 page)
Front Panel Assembly	D03159700 (page 1 only)

NOTE: For those who do their own maintenance and repair, it may be desirable to stock a set of spares so that out-of-service time can be kept to a minimum. Factory service records indicate that the Recommended Spares in Table 4-1 will meet most emergencies.

Table 4-1. Recommended Spares

SIERRA PART NUMBER	DESCRIPTION	QTY.
901400503	Capacitor, ceramic disc 0.05 μ F	2
901900680	Capacitor, dipped Mica 68 pF 2%	1
907306040	Resistor, Film, Metal 604 Ohm , 1/8 W 1%	1
907349R90	Resistor, Film, Metal 49.9 Ohm 1/8 W 1%	3
907361R90	Resistor, Film, Metal 61.9 Ohm 1/8 W 1%	3
910000136	Transformer Assembly	2
910304258	Logic Switch, S1, 2N4258, PNP	3
910633051	Zener Diode, 1N3051B	1
911200263	Switch, Rotary, S1	2
911200276	Switch, Rotary, 1 Pole, 12 POS	1
911200277	Switch, Rotary, 1 pole, 10 POS	1
911800160	Meter, M1	3
912200191	Crystal, 6.176 MHz	1
912200193	Crystal 12.608 MHz	2
912400004	Oscillator Crystal Controlled Clock, 6.3 MHz	1
913400012	Fuse Holder, Screwdriver Slot	2
913800060	Lamp, Incandescent, T1 flange base	5
913800063	Lamp Holder, white without lamp	2
913800065	Lamp Holder, Red without lamp	1
914400036	Phone Jack	3
914800120	Connector, PCB, 12 PIN	3
914800151	Contact Housing, 10 Dual Position	2
914800196	Connector Receptacle, Shell, 5 Pin, Nylon	3
914810073	Connector Receptacle, 10 Circuit, PC	2
915600012	Bumper, Rubber, No-Mar Black	2
920300301	I. C., LM301AN, Operational Amplifier	2
920300555	I. C., NE555 V LM555CN, Timer	1
920301596	I. C., MC1596L, Modulator - Demodulator	2
920304136	I. C., RCA136, Quad, Operational Amplifier	5
920307428	I. C., SN74LS28, Quad, 2-Input NOR Gate	3
920307805	I. C., 7805UC, +5 Volt Regulator	1
920317420	I. C., SN74LS20, Dual 4 Input NAND Gate	2
920317427	I. C., SN74LS27, Triple 3 Input NOR Gate	2
920317473	I. C., SN74LS75N, Dual J-K Flip Flop	3
920317474	I. C., SN74LS74, Dual Flip Flop W/Preset & Clear	2
920317486	I. C., SN7486PC, Quad, 2 Input Exclusive OR Gate	3
920327400	I. C., SN74LS00N, Quad, 2 Input NAND Gate	3
920327410	I. C., SN74LS10N, Triple, 3 Input NAND Gate	3
920337402	I. C., SN74LS02N Quad, NOR Gate	2
920337496	I. C., SN74LS96, 5 Bit Shift Register	1
920374197	I. C., SN74LS19M, Binary Counter/Latch	3
920400032	Meter Bezel	3

8

7

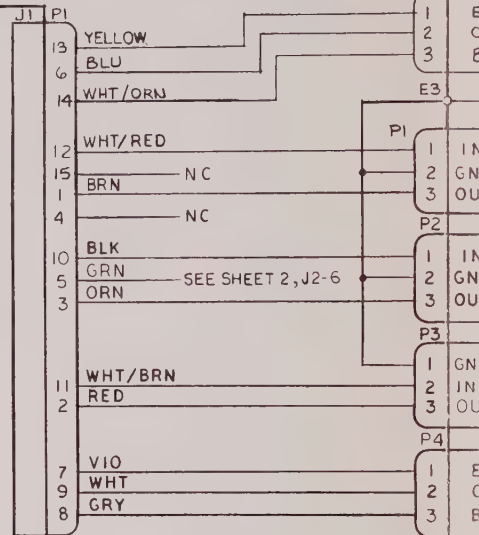
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5

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PART OF
A1

ASSY A03149101
SCHEM D03197600



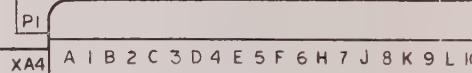
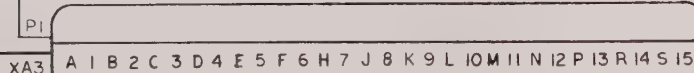
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ASSY A03149501
SCHEM D0319800
ERROR DETECTOR

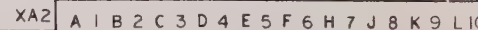
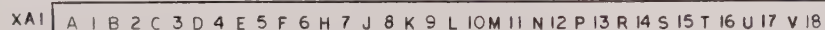
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ASSY A03149701
SCHEM D03197900

PART OF
A8



ASSY D03156900
SCHEM D03158500
MOTHERBOARD



ASSY A03149101
SCHEM D03197600
POWER SUPPLY/METER DRIVE

A1

ASSY A03149300
SCHEM D03197700
CORRELATOR

A2

NOT-S

1. ☐

2. FUS

3. SW

4. ALI

RESISTOR ASSY
C03439700

Q2
2N5655

VR3
78M15UC

VR2
7805UC

VR1
MC7915CP

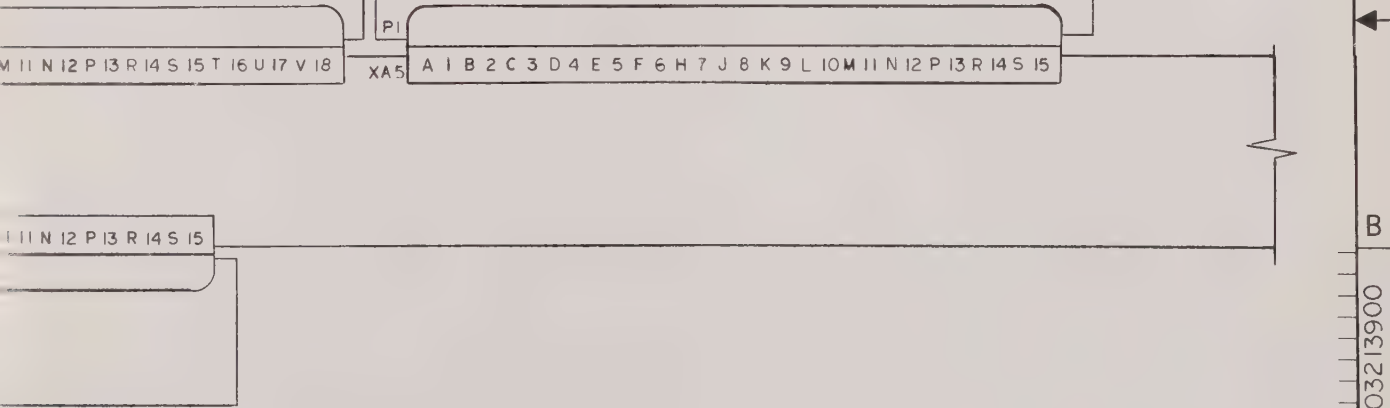
Q1
MJE3055

CHANGE EFFECTIVE		REVISIONS			
MODEL	SERIAL	ZONE	LTR	DESCRIPTION	DATE APPROVED
			A	PILOT RUN RELEASE	6-22-76 FAULL
			A2	PCO 1478, 1563	RAM 8-18-76 MLD
			A6	PCO 1988, 1989, 1990, 2015	
			B	PREPRODUCTION RELEASE	4/7/77 Paul
				PRODUCTION RELEASE	6-7-77 Paul
			C	ECO 16993	10-1-79 B&D
415A-2	1754+UP	-	D	ECO 17687	3-26-81
415A-2	1754+UP	-	E	ECOS 17821 & 17869	8-15-81
			F	PER ECO 17977	5-12-82
			G	PER ECO 19272	10-23-84

SIERRA ELECTRONIC SERVICE, INC
10000 WILLOW GROVE
MONTROSE, CO 80646

A5A

ASSY A03149900
SCHEM D03198000
QRW & 4B3T GENERATOR



UNLESS OTHERWISE SPECIFIED:
DENOTES FRONT PANEL MARKINGS
115VAC, 1/4 AMP. SLOW BLOW
230VAC, 1/8 AMP. SLOW BLOW
SHOWN IN 115VAC POSITION
DISTANCE VALUES ARE IN OHMS

QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
LIST OF MATERIAL OR PARTS LIST								
ALL THREADS UNIFIED SERIES, EXTERNAL THREADS TO BE CLASS 2A; INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED				✓ FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED. REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.		DO NOT SCALE DWG. DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.	Sierra CODE IDENT. NO. LEAR SIEGLER, INC. SIERRA ELECTRONIC DIVISION MENLO PARK, CALIFORNIA 94023 54778	
TOLERANCE UNLESS SPECIFIED				BASIC TWO PLACE THREE PLACE UP TO 6 ± .02 ± 6 TO 24 ± .03 ± ABOVE 24 ± .06 ±		INTERCONNECT DIAGRAM 415A-2		
ASSY. OR ITEM				QTY. NEXT		DATE 2-1-76		SIZE
NEXT ASSY.				MODEL NO.		BY D		DRAWING NO.
APPLICATION				415A-2		CHECKED		D03213900
						APPR		G
						SCALE		STOCK AS
						SHEET		1 OF 3

8

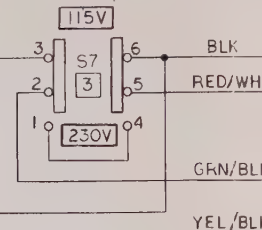
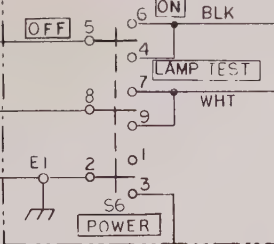
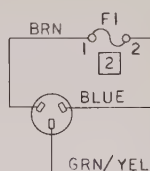
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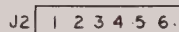
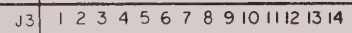
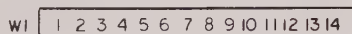
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PART OF F/P ASSY
ASSY D03554000

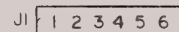
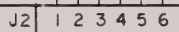


PART OF
A8

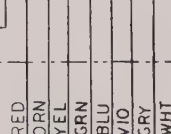
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SCHEM D03198500



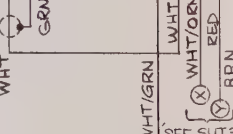
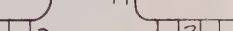
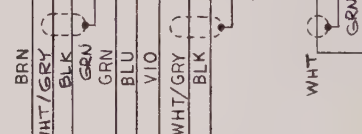
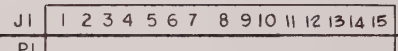
A9
ASSY A03156400
SCHEM D03198600



BRN



PULSE PERIOD



E2

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

PULSE PERIOD

S2

REF

AUTO

HOLD

J4

FAULT LINE MON

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

SEE SHT.3

4

3

2

1

POWER TRANSFORMER
ASSY C03181900

RED

WHT/GRN

GRN

BLU/BLK

WHT/BLU

WHT

GRY

ORN

BRN

KEY-NC

P4

J4

1 2 3 4 5 6 7 8 9 10

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
		SEE SHEET 1	

1 2 3 4 5 6 7 8 9 10 11 12 13 14

1 2 3 4 5 6 7 8 9 10 11 12 13 14

TP GND

GRN

E5

PART OF
CHASSIS

J2

P2

1 2 3 4 5 6 7 8 9 10

J1

J2

5 3 4 2 1 6 7 10 9 8

WHT/GRN ORN YEL RED BRN NC NC GRN

GRN

E4

SEE SHT 1
AIPI-5PART OF: F/P
ASSY D03554000J6
PCM SIG IN
(TT)J1
PCM SIG IN
(310)

PART OF CHASSIS

R1
10
1/8 W
1%

QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
LIST OF MATERIAL OR PARTS LIST								
ALL THREADS UNIFIED SERIES, EXTERNAL THREADS TO BE CLASS 2A; INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED.				✓ FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED. REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.				
DO NOT SCALE DWG.				DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.				
TOLERANCE UNLESS SPECIFIED				BASIC TWO PLACE THREE PLACE UP TO 6 ± .02 ± 6 TO 24 ± .03 ± ABOVE 24 ± .06 ± ANGULAR DIMENSION ±				
ASSY. OR ITEM				QTY. NEXT		NEXT ASSY.		MODE. NO.
APPLICATION				415A-2		FINISH:		
DATE				BY		CHECKED		APPR
SIZE				DRAWING NO.		REV.		
D				D03213900		G		
SCALE				STOCK AS		SHEET		2 OF 3

ALL THREADS UNIFIED SERIES, EXTERNAL THREADS TO BE CLASS 2A; INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED.

✓ FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED.
REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DWG.
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.

Sierra
LEAR SIEGLER, INC.
SIERRA ELECTRONIC DIVISION
MENLO PARK, CALIFORNIA 94025

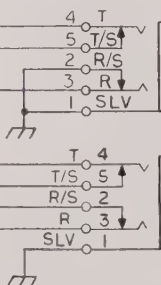
CODE IDENT. NO.
54778

INTERCONNECT DIAGRAM
415A-2

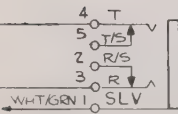
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BY: [Signature]
CHECKED: [Signature]
APPR: [Signature]

SIZE: D
DRAWING NO.: D03213900
REV.: G

SCALE: STOCK AS
SHEET: 2 OF 3

SEE SHT 3, A8P2-12
SEE SHT 3, A8P2-11WHT/RED
WHT/BRN

J5
FAULT LINE REC
(310)



D

C

B

A

D03213900
DWG. NO.

8

7

6

5

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PART OF
A8

ASSY D03156900
SCHEM D03198500

J3 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

P3

WHT/GRN
WHT/YEL

BLK
WHT/GRY

WHT/BRN
BLK

WHT
GRY

VIO
BLU

GRN
YEL

ORN
BRN

RED → SEE SHT 2
S6-3

J2 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

P2

SEE SHT 2
J5 SLV
SEE SHT 2
J1-R
SEE SHT 2
J1-T

WHT/GRN

WHT-RED

WHT/BRN

NC

BLK

WHT

GRY

BLU

GRN

YEL

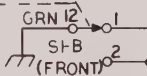
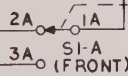
ORN

RED

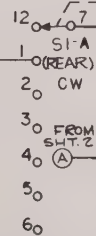
BRN

NORMA

PART OF F/P
ASSY D03554000



FUNCTION



FROM SHT. 2

SEE SHT. 2
SEE SHT. 2

DS12 PULSES

DS11 OSC LINE

DS10 ERF

DS13

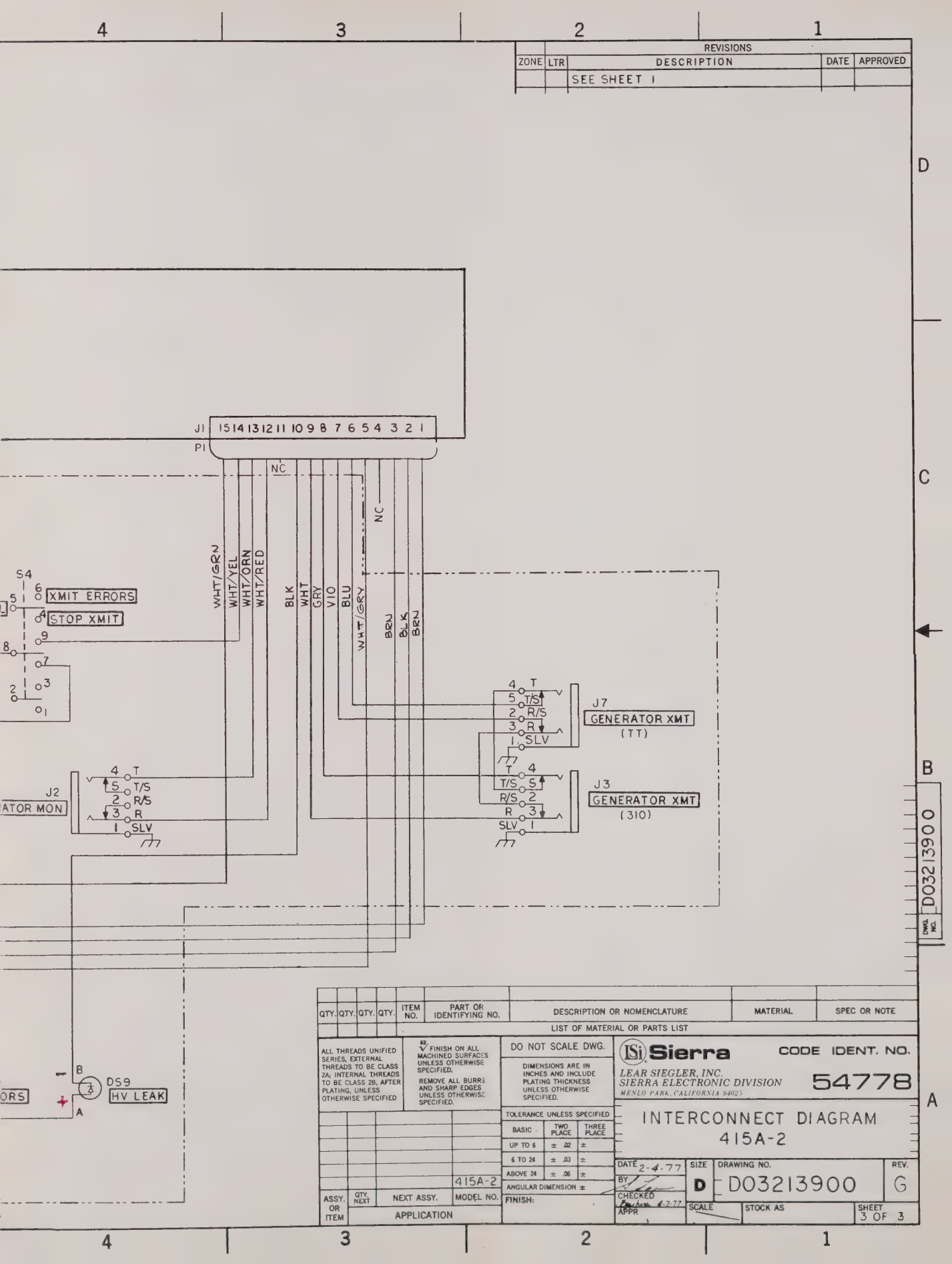
POWER

8

7

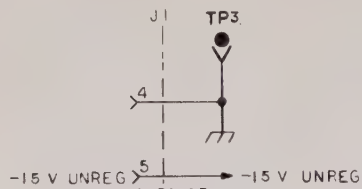
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5



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VOLTAGE COMPENSATION
+5V REG



FRONT PANEL
CURRENT ADJUST

PART OF
TRANSISTOR
PANEL

REPEATER CURRENT SOURCE MEASURING CIRCUITS

REFERENCE DESIGNATION DATA

LAST USED	NOT USED
A4	-
C17	C8
CR16	-
J1	-
K1	-
Q8	-
R41	-
U5	-

C-18 .1uf ceramic 50V
901300104

4

3

2

1

REVISIONS					
SERIAL	MODEL	ZONE	LTR	DESCRIPTION	DATE
			A	PRODUCTION RELEASE PER ECO 17687	3-31-81
1754 & ON	415A-2		B	PER ECO 17521	7-16-81
1754 & ON	415A-2		C	PER ECO 17567	7-16-81
			D	PER ECO 17841	
			E	PER ECO 17977	KW 5-17-82
			E1	ECO 18868	JD 2-16-84
			F	ECO 19023	CM 3-30-84
			G	ECO 19496	DB 2-13-85

PART OF
PI

T VOLTAGE COMP OUT

S CURRENT MEAS

R VOLTAGE MEAS

U FRONT PANEL, HV TEST SWITCH RPTR SUPPLY

FRONT PANEL -
FUNCTION SWITCHPART OF
J1

8 (BASE)

7 (EMITTER)

Q1
MJE.3055
CHASSIS
ASSY

9 (COLLECTOR)

-15V UNREG

PI

E

L

H

H

H

H

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NOTES - UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL RESISTORS ARE 1/8W, $\pm 1\%$
3. ALL CAPACITANCE VALUES ARE IN MICROFARADS

4 SEE TABLE "A"

QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
LIST OF MATERIAL OR PARTS LIST								
ALL THREADS UNIFIED SERIES, EXTERNAL THREADS TO BE CLASS 2A, INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED.					FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED. REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.			
DO NOT SCALE DWG.					DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.			
TOLERANCE UNLESS SPECIFIED					BASIC TWO THREE PLACE UP TO 6 $\pm .02$ $\pm$ 6 TO 24 $\pm .03$ $\pm$ ABOVE 24 $\pm .06$ $\pm$ ANGULAR DIMENSION $\pm$ FINISH:			
ASSY. OR ITEM QTY. NEXT NEXT ASSY. MODE. NO. APPLICATION					415A-2 DATE 3-31-81 BY UGA LE CHECKED APPR			
SCALE STOCK AS SHEET 1 OF 2					CODE IDENT. NO. 54778 LEAR SIEGLER, INC. SIERRA ELECTRONIC DIVISION MENLO PARK, CALIFORNIA 94025 415A-2, SCHEMATIC, AI POWER SUPPLY/METER DRIVE DRAWING NO. D DO3407700 REV. C			

D

C

B

A

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

DO3407700

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DO3407700

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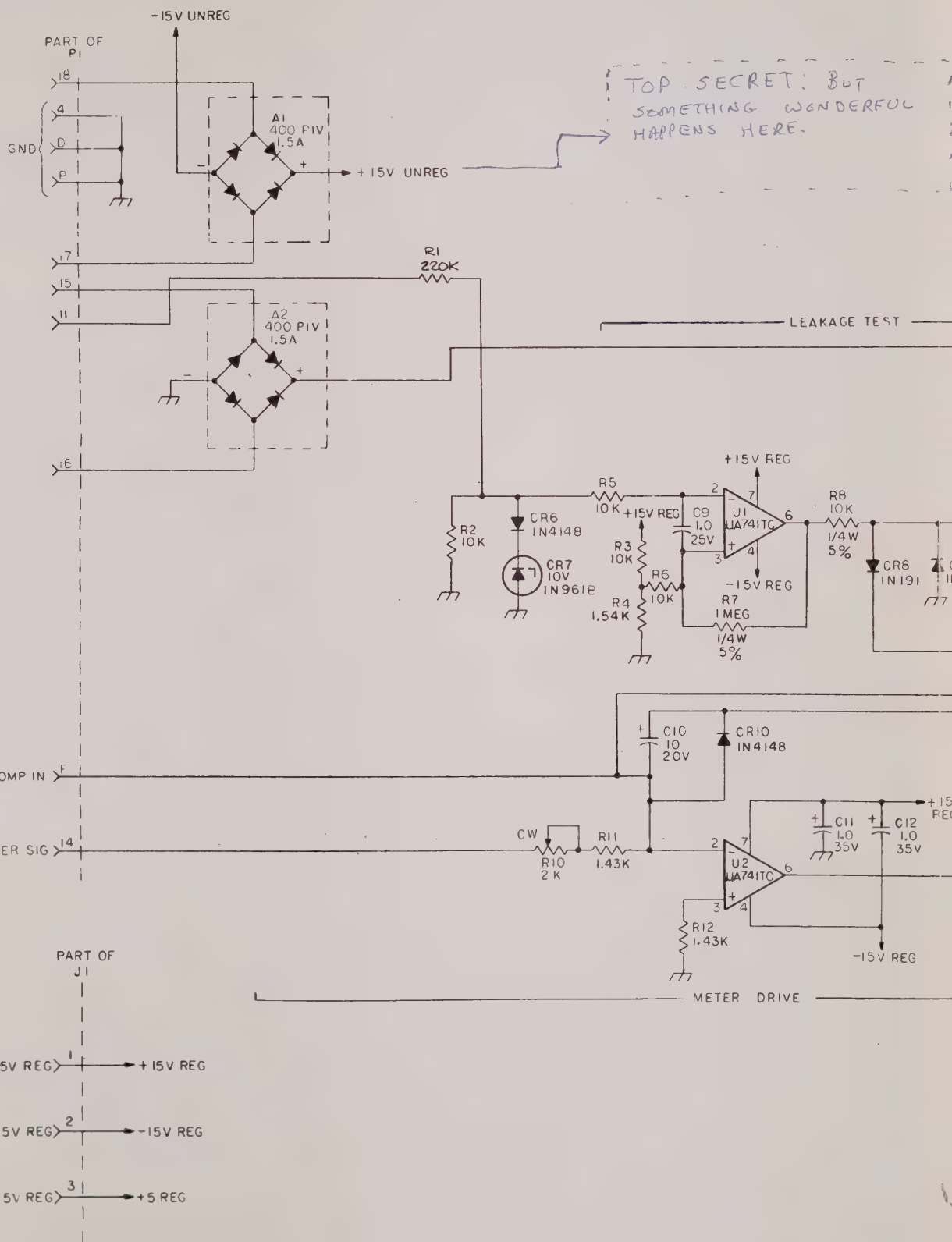
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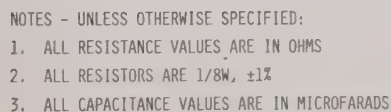
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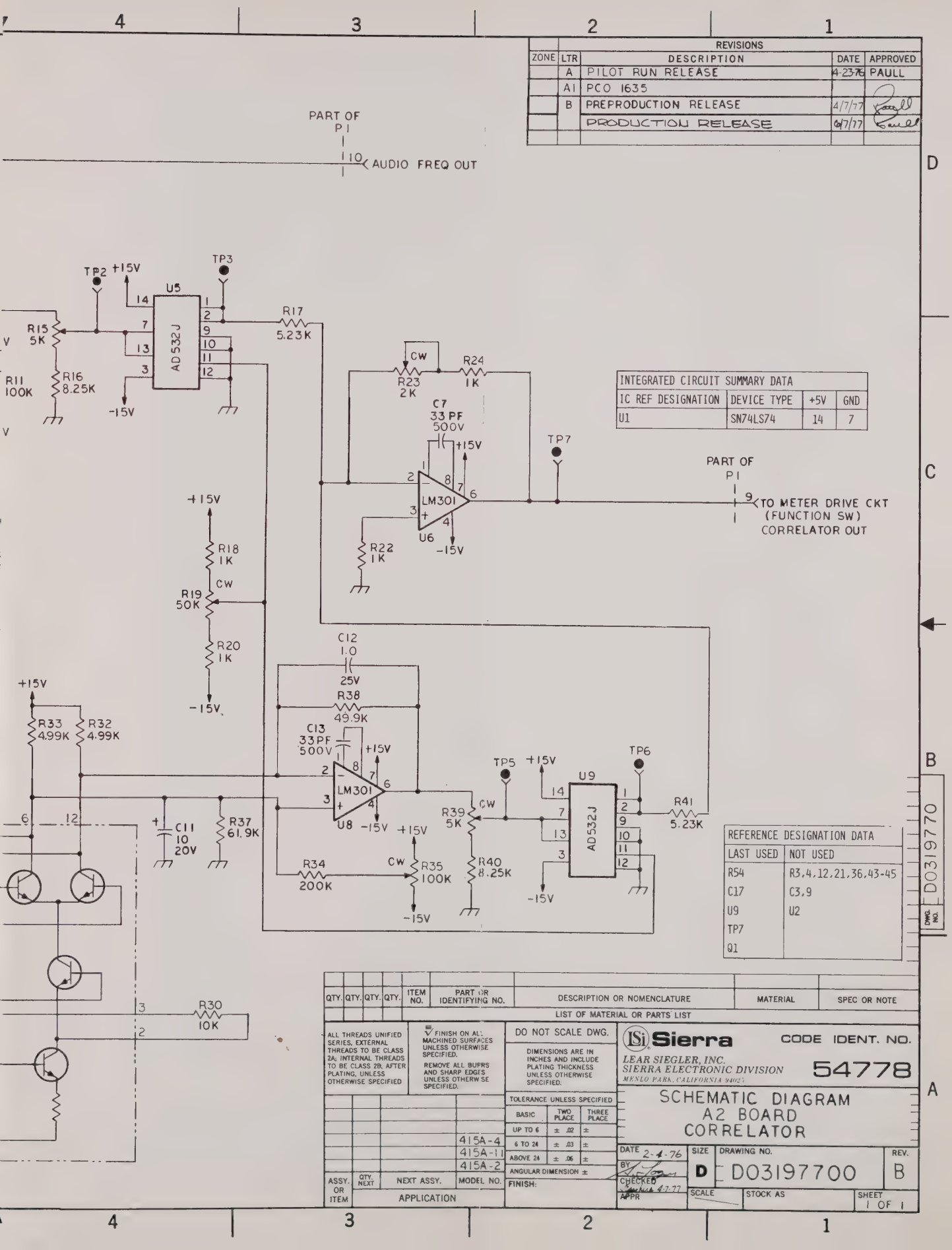
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PART OF PI





Parts List for 415A-2, A3 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A3 PCB	Power Board Assembly for 415A-2	A03149500
C1	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C2	Capacitor Tantalum 1 uF 10% 35V	902740105
C3	Capacitor Plastic 1.0 uF 25V	903300105
C4	Capacitor Tantalum 1 uF 10% 35V	902740105
C5	Capacitor Dipped Mica 82 pF 2% 500V	901900820
C6	Capacitor Tantalum 1 uF 10% 35V	902740105
C7	Capacitor Tantalum 22 uF 20% 15V	902740226
C8	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C9	Capacitor Tantalum 1 uF 10% 35V	902740105
C10	Capacitor Tantalum 1 uF 10% 35V	902740105
C11	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C12	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C13	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C14	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C15	Capacitor Dipped Mica 150 pF 5% 500V	901900151
C16	Capacitor Ceramic 0.1 uF 20% 50V	901300104
CR 01	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 02	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 03	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 04	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 05	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 06	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 07	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 08	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 10	Diode GE 1N3666 80V 200 mA 75 mW	910503666
R1	Resistor Fxd Comp 160 Ohm 5% 1/4W	906900161
R2	Resistor Metal Film 200 Ohm 1% 1/8W	907302000
R4	Resistor Fxd Film 1.0k Ohm 1% 1/8W	907301001
R5	Resistor Comp 1 Meg Ohm 5% 1/4W	906900105
R6	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R7	Resistor Fxc Comp 330 Ohm 5% 1/4W	906900331
R8	Resistor Fxd Film 1.0k Ohm 1% 1/8W	907301001
R9	Resistor Comp 1 Meg Ohm 5% 1/4W	906900105
R10	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R11	Resistor Fxd Comp 160 Ohm 5% 1/4W	906900161
R12	Resistor Metal Film 40.2k Ohm 1% 1/8W	907304022
R13	Resistor Metal Film 3.40k Ohm 1% 1/8W	907303401
R15	Resistor Metal Film 6.04k Ohm 1% 1/8W	907306041
R16	Resistor Metal Film 1.05k Ohm 1% 1/8W	907301051
R17	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R18	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R19	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R20	Resistor Metal Film 73.2k Ohm 1% 1/8W	907307322
R21	Resistor Metal Film 68.1k Ohm 1% 1/8W	907306812

When given, manufacturer's part numbers are only to aid identification.
Equivalent components from other suppliers may sometimes be substituted.

Parts List for 415A-2, A3 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
R22	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R23	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R24	Resistor Metal Film 150k Ohm 1% 1/8W	907301503
R25	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R26	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R27	Resistor Fxd Comp 22 Ohm 5% 1/4W	906900220
R28	Resistor Fxd Comp 22 Ohm 5% 1/4W	906900220
R29	Resistor Fxd Comp 22 Ohm 5% 1/4W	906900220
R30	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R31	Resistor Fxd Comp 1k Ohm 5% 1/4W	906900102
R32	Resistor Comp 680 Ohm 5% 1/4W	906900681
R33	Resistor Fxd Comp 51 Ohm 5% 1/4W	906900510
R34	Resistor Metal Film 82.5k Ohm 1% 1/8W	907308252
T1	Transformer Toroidal 6 MH 20% CTI to ICT	909300013
U1	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U2	IC SN74LS193N Counter	920384193
U3	IC SN74LS04N Hex Inverter	920327404
U4	IC SN74LS10N Triple 3 Input Nand Gate	920327410
U5	IC FSA2719M Diode Array	920302719
U6	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U7	IC SN74LS75N Dual J-K Flip-Flop	920317473
U8	IC SN74LS10N Triple 3 Input Nand Gate	920327410
U9	IC LM319N Dual Comparator High Speed	920300319
U10	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U11	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U12	IC SN74LS10N Triple 3 Input Nand Gate	920327410
U13	IC 96L02PC Dual Flip-Flop	920309602
U14	IC SN74LS73N Dual J-K Flip-Flop	920317473
U15	IC SN75492PC Mos to Vled Driver	920375492
U16	IC 96L02PC Dual Flip-Flop	920309602

When given, manufacturer's part numbers are only to aid identification.
Equivalent components from other suppliers may sometimes be substituted.

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SEE SHEET 1

A

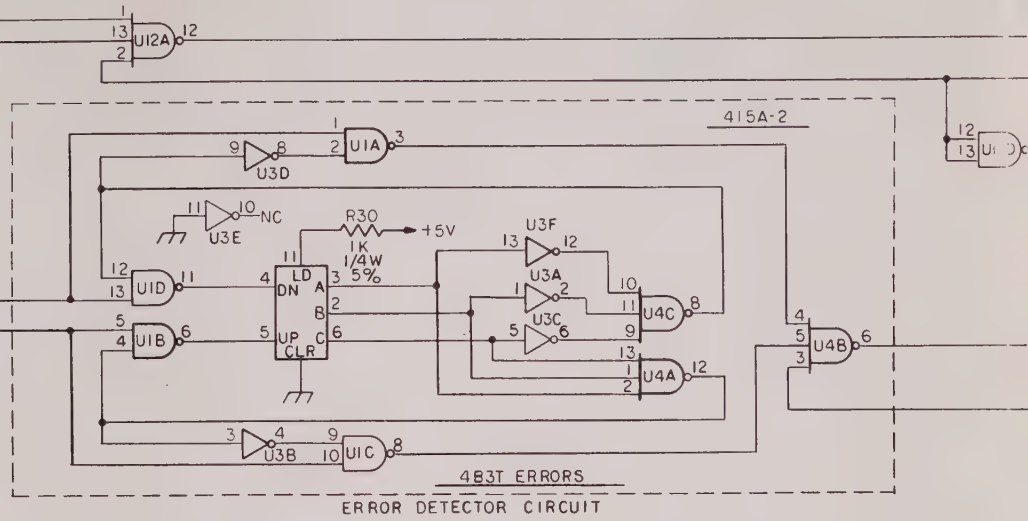
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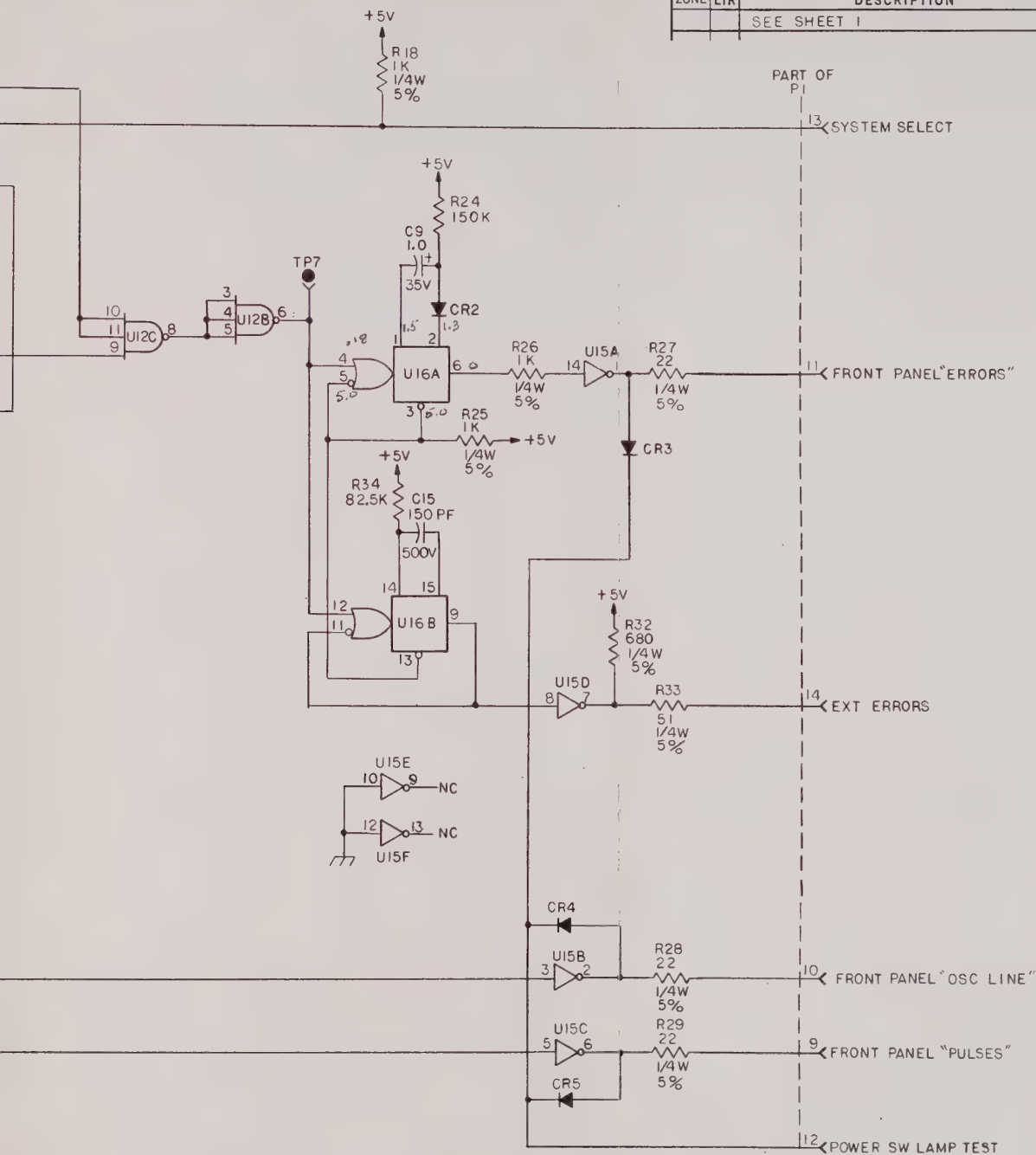
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REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SHEET 1		



QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
LIST OF MATERIAL OR PARTS LIST								
ALL THREADS UNIFIED SERIES EXTERNAL THREADS TO BE CLASS 2A; INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.				DO NOT SCALE DWG.		 Sierra CODE IDENT. NO.		
				DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.		LEAR SIEGLER, INC. SIERRA ELECTRONIC DIVISION MENLO PARK, CALIFORNIA 94025		
				TOLERANCE UNLESS SPECIFIED		54778		
				BASIC TWO PLACE THREE PLACE		A3 ERROR DETECTOR		
				UP TO 6 ± .02 ±		DATE 2/4/77		
				6 TO 24 ± .03 ±		SIZE DRAWING NO.		
				ABOVE 24 ± .06 ±		D D03197800		
				ANGULAR DIMENSION ±		REV.		
415A-2				FINISH:		D D03197800		
ASSY. OR ITEM				NEXT ASSY.		CHECKED 2-7-77		
MODEL NO.				APPLICATION		SCALE STOCK AS		
						SHEET 2 OF 4		

Parts List for 415A-2, A4 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A4 PCB	Power Board Assembly for 415A-2	A03149700
A1	Diode Bridge Assy MDS920A-1 1 Amp 25V	910809201
C16	Capacitor Dipped Mica 82 pF 2% 500V	901900820
C17	Capacitor Tantalum 10 uF 10% 20V	902720106
C18	Capacitor Tantalum 10 uF 10% 20V	902720106
C19	Capacitor Ceramic .05 uF 500V	901400503
C20	Capacitor Tantalum 1 uF 10% 35V	902740105
C21	Capacitor Tantalum 1 uF 10% 35V	902740105
C22	Capacitor Tantalum 1 uF 10% 35V	902740105
C23	Capacitor Tantalum 1 uF 10% 35V	902740105
C25	Capacitor 100 pF 50% 500V	901900101
C26	Capacitor 100 pF 50% 500V	901900101
C27	Capacitor Ceramic 0.1 uF $\pm 20\%$ 50V	901300104
C28	Capacitor Ceramic 0.1 uF $\pm 20\%$ 50V	901300104
C29	Capacitor Ceramic 0.1 uF $\pm 20\%$ 50V	901300104
C30	Capacitor Ceramic 0.1 uF $\pm 20\%$ 50V	901300104
CR 01	Diode Zener 1N3829A 6.8V 5%	910633829
CR 02	Diode 1N4148	910504148
CR 03	Diode 1N4148	910504148
L1	Inductor 56 uH	909000141
Q8	Transistor SI PN4258/2N4258 NPN	910304258
Q9	Transistor SI PN4258/2N4258 NPN	910304258
Q10	Transistor 2N3904	910303904
R11	Resistor Comp 470 Ohm 5% 1/4W	906900471
R12	Resistor Comp 470 Ohm 5% 1/4W	906900471
R26	Resistor Comp 10k Ohm 5% 1/4W	906900103
R27	Resistor Comp 10k Ohm 5% 1/4W	906900103
R28	Resistor Comp 10k Ohm 5% 1/4W	906900103
R29	Resistor Comp 10k Ohm 5% 1/4W	906900103
R30	Resistor Comp 10k Ohm 5% 1/4W	906900103
R31	Resistor Comp 10k Ohm 5% 1/4W	906900103
R32	Resistor Comp 10k Ohm 5% 1/4W	906900103
R33	Resistor Comp 10k Ohm 5% 1/4W	906900103
R34	Resistor Comp 10k Ohm 5% 1/4W	906900103
R35	Resistor Comp 10k Ohm 5% 1/4W	906900103
R36	Resistor Fxd Film 1.0k Ohm 1% 1/8W	907301001
R37	Resistor Metal Film 1.82k Ohm 1% 1/8W	907301821
R38	Resistor Fxd Film 1.0k Ohm 1% 1/8W	907301001
R39	Resistor Fxd Film 1.0k Ohm 1% 1/8W	907301001
R40	Resistor Metal Film 249 Ohm 1% 1/8W	907302490
R41	Resistor Metal Film 249 Ohm 1% 1/8W	907302490
R42	Resistor Metal Film 36.5 Ohm 1% 1/8W	907336R50
R43	Resistor Comp 560 Ohm 5% 1/4W	906900561
R44	Resistor Metal Film 36.5 Ohm 1% 1/8W	907336R50
R45	Resistor Fxd Film 5.9 Ohm 1% 1/8W	907305R90

When given, manufacturer's part numbers are only to aid identification.
Equivalent components from other suppliers may sometimes be substituted.

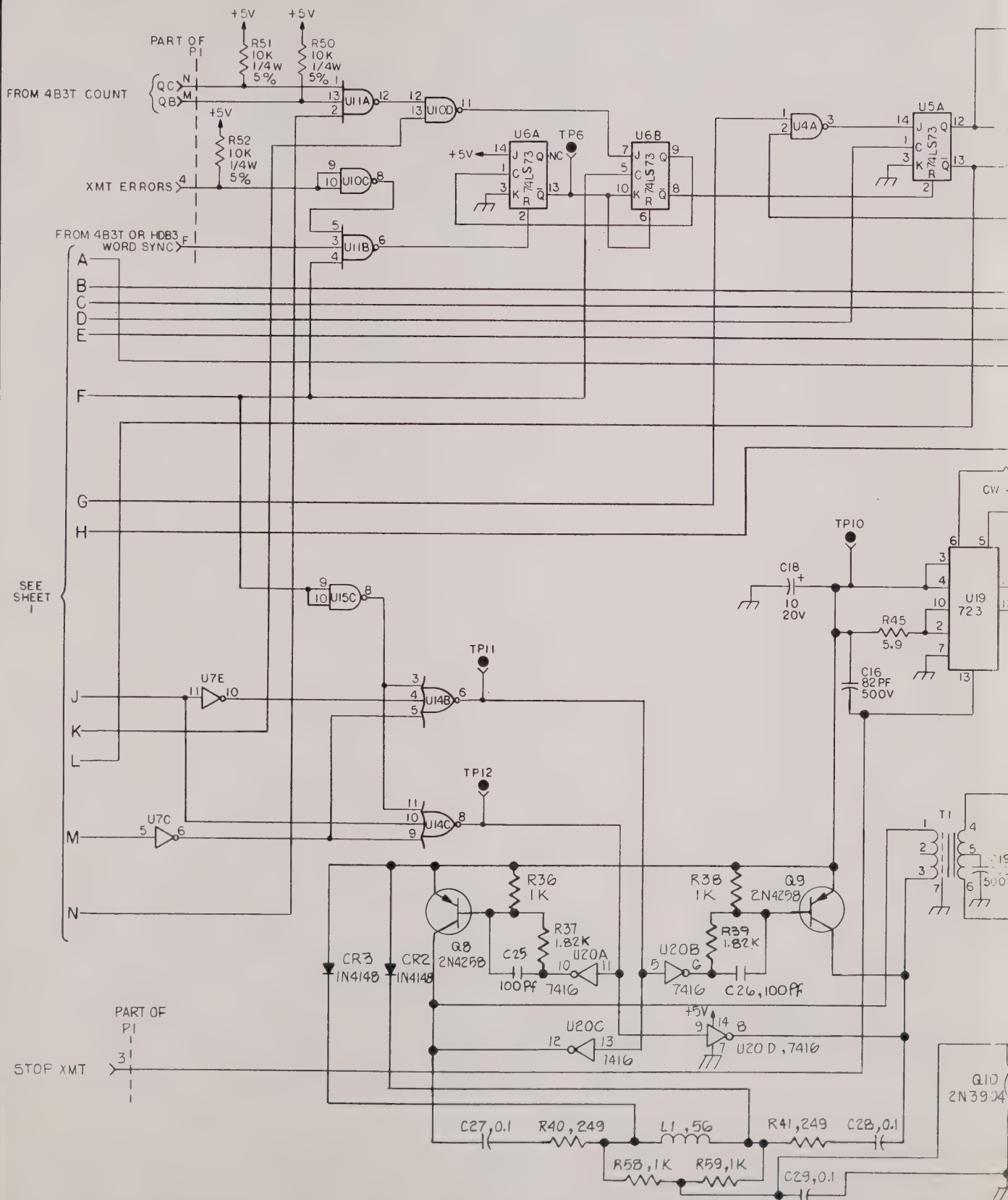
Parts List for 415A-2, A4 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
R46	Potentiometer 1k 10% 15 Turn PC Mtg	907900290
R47	Resistor Metal Film 1.87k 1% 1/8W	907301871
R48	Resistor Comp 10k Ohm 5% 1/4W	906900103
R50	Resistor Comp 10k Ohm 5% 1/4W	906900103
R51	Resistor Comp 10k Ohm 5% 1/4W	906900103
R52	Resistor Comp 10k Ohm 5% 1/4W	906900103
R56	Resistor WW 5.6 Ohm 5% 2W	906205R60
R57	Resistor WW 5.6 Ohm 5% 2W	906205R60
R58	Resistor Metal Film 1.0k 1% 1/8W	907301001
R59	Resistor Metal Film 1.0k 1% 1/8W	907301001
R60	Resistor 3.9k 5% 1/4W	906900392
R61	Resistor 1k 5% 1/4W	906900102
T1	Transformer w/Electrostatic Shield	909910013
U1	IC SN74LS20N Dual 4 Input Nand Gate	920317420
U2	IC 74LS86PC Quad 2 Input Exclusive or Gate	920317486
U3	IC SN74LS02	920327402
U4	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U5	IC SN74LS75N Dual J-K Flip-Flop	920317473
U6	IC SN74LS75N Dual J-K Flip-Flop	920317473
U7	IC SN74LS04N Hex Inverter	920327404
U8	IC 74LS86PC Quad 2 Input Exclusive or Gate	920317486
U9	IC SN74193N Synchronous Up/Down Counter	920384193
U10	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U11	IC SN74LS10N Triple 3 Input Nand Gate	920327410
U12	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U13	IC 74LS30PC 8 Input Nand Gate	920317430
U14	IC SN74LS27N Dual 4 Input Nand Gate	920317427
U15	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U16	IC SN74LS04N Hex Inverter	920327404
U17	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U18	IC SN74LS75N Dual J-K Flip-Flop	920317473
U19	IC LM723CD Voltage Regulator	920300723
U20	IC SN7416N	920307416

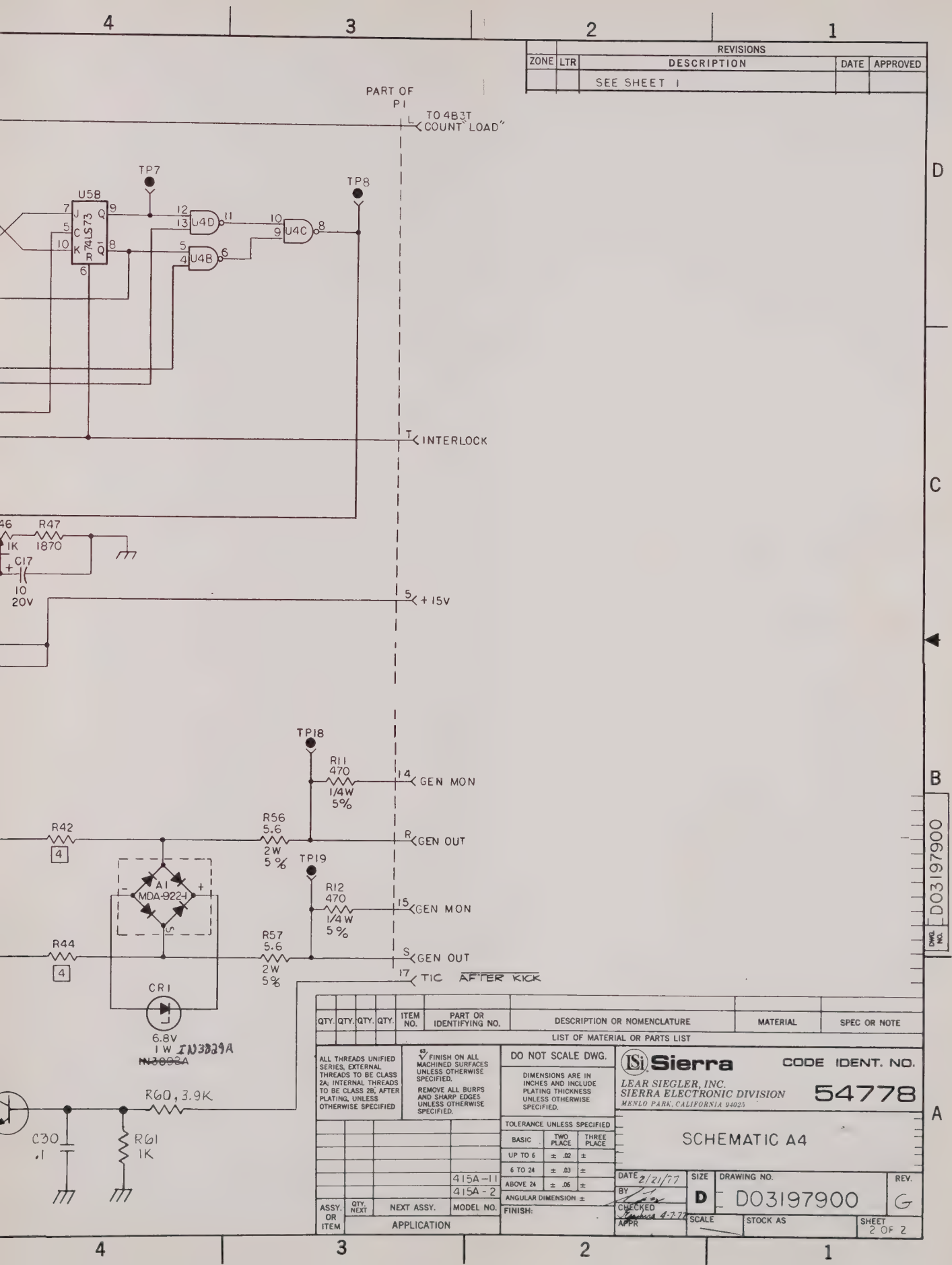
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Parts List for 415A-2, A5 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A5 PCB	Power Board Assembly for 415A-2	A03149900
C1	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C2	Capacitor Mica 24 pF 2% 500 VDCW	901900240
C3	Capacitor Dura Mica 27 pF 2% 500V	901910270
C4	Capacitor Dipped Mica 30 pF 2% 500V	901900300
C5	Capacitor Tantalum 1 uF 10% 35V	902740105
C6	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C7	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C8	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C9	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C10	Capacitor Ceramic 0.1 uF 20% 50V	901300104
C11	Capacitor Ceramic 0.1 uF 20% 50V	901300104
Q1	Transistor SI PN4258/2N4258 NPN	910304258
Q2	Transistor SI PN4258/2N4258 NPN	910304258
Q3	Transistor SI PN4258/2N4258 NPN	910304258
Q4	Transistor SI PN4258/2N4258 NPN	910304258
Q5	Transistor SI 2N3906 PNP	910303906
R1	Resistor Fax Film 2.43k Ohm 1% 1/8W	907302431
R2	Resistor Fax Film 2.43k Ohm 1% 1/8W	907302431
R3	Resistor Metal Film 750 Ohm 1% 1/8W	907307500
R4	Resistor Metal Film 1.21k Ohm 1% 1/8W	907301211
R5	Resistor Metal Film 1.21k Ohm 1% 1/8W	907301211
R6	Resistor Fxd Film 1.82k Ohm 1% 1/8W	907301821
R7	Resistor Metal Film 1.05k Ohm 1% 1/8W	907301051
R8	Resistor Fxd Film 432 Ohm 1% 1/8W	907304320
R9	Resistor Com Junc Network 2.2k Ohm 2% 0.2W	920680222
R10	Resistor Comp 10k Ohm 5% 1/4W	906900103
R11	Resistor Metal Film 750 Ohm 1% 1/8W	907307500
R12	Resistor Comp 10k Ohm 5% 1/4W	906900103
R13	Resistor Comp 10k Ohm 5% 1/4W	906900103
R14	Resistor Comp 10k Ohm 5% 1/4W	906900103
R15	Resistor Comp 10k Ohm 5% 1/4W	906900103
R16	Resistor Metal Film 1.05k Ohm 1% 1/8W	907301051
U1	IC 74LS164PC 8 Bit Out Shift Register	920374164
U2	IC SN74LS27N Dual 4 Input Nand Gate	920317427
U3	IC 74LS164PC 8 Bit Out Shift Register	920374164
U4	IC SN74LS27N Dual 4 Input Nand Gate	920317427
U5	IC 74LS164PC 8 Bit Out Shift Register	920374164
U6	IC 74LS30PC 8 Input Nand Gate	920317430
U7	IC 74LS30PC 8 Input Nand Gate	920317430
U8	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U9	IC 74LS86PC Quad 2 Input Exclusive or Gate	920317486
U10	IC SN74LS02N	920327402
U11	IC SN74LS75N Dual J-K Flip-Flop	920317473
U12	IC SN74LS04N Hex Inverter	920327404

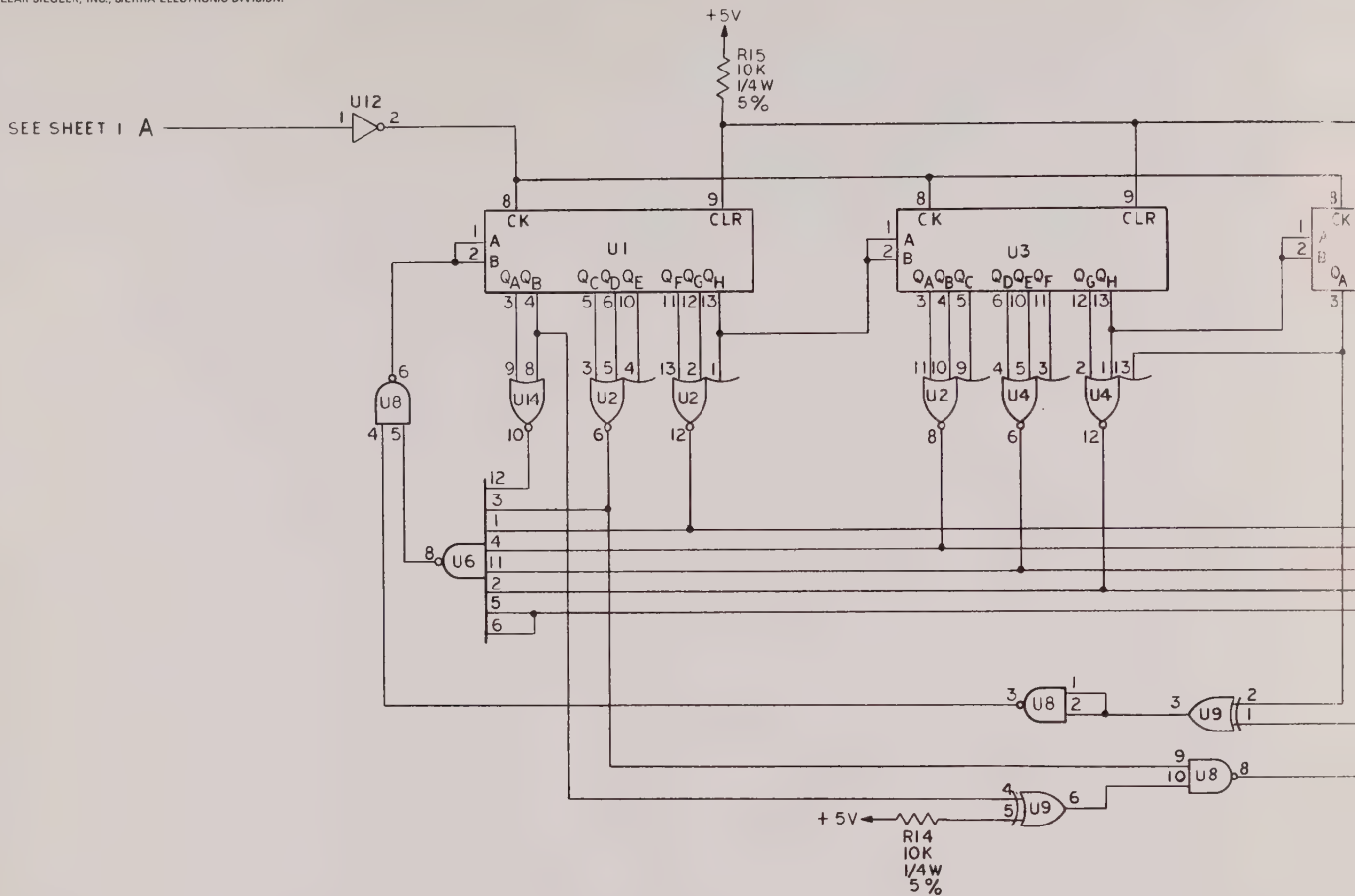
When given, manufacturer's part numbers are only to aid identification.
Equivalent components from other suppliers may sometimes be substituted.

Parts List for 415A-2, A5 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
U13	IC CA3127E Transistor Array NPN	920303127
U14	IC SN74LS02	920327402
U15	IC 74LS95PC 4 Bit Shift Register	920307495
U16	IC 74LS86PC Quad 2 Input Exclusive or Gate	920317486
U17	IC SN74LS75N Dual J-K Flip-Flop	920317473
U18	IC 74LS86PC Quad 2 Input Exclusive or Gate	920317486
U19	IC 74LS95PC 4 Bit Shift Register	920307495
U20	IC SN74LS02	920327402
U21	IC SN74LS00N Quad 2 Input Nand Gate	920327400
U22	IC SN74LS96 5 Bit Shift Register	920337496
U23	IC SN74LS96 5 Bit Shift Register	920337496
U24	IC 82S23 256 Bit Programmable ROM 32X8 PROM	920308223
U25	IC SN74LS193N Synchronous Up/Down Counter	920384193
XY1	Clip Crystal Holding Steel	921100004
XY2	Clip Crystal Holding Steel	921100004
XY3	Clip Crystal Holding Steel	921100004
Y1	Crystal 12.608 MHz	912200193
Y2	Crystal 9.456 MHz	912200258
Y3	Crystal 6.176 MHz	912200191

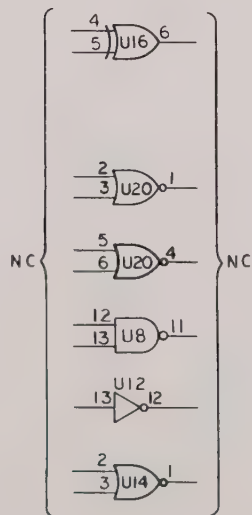
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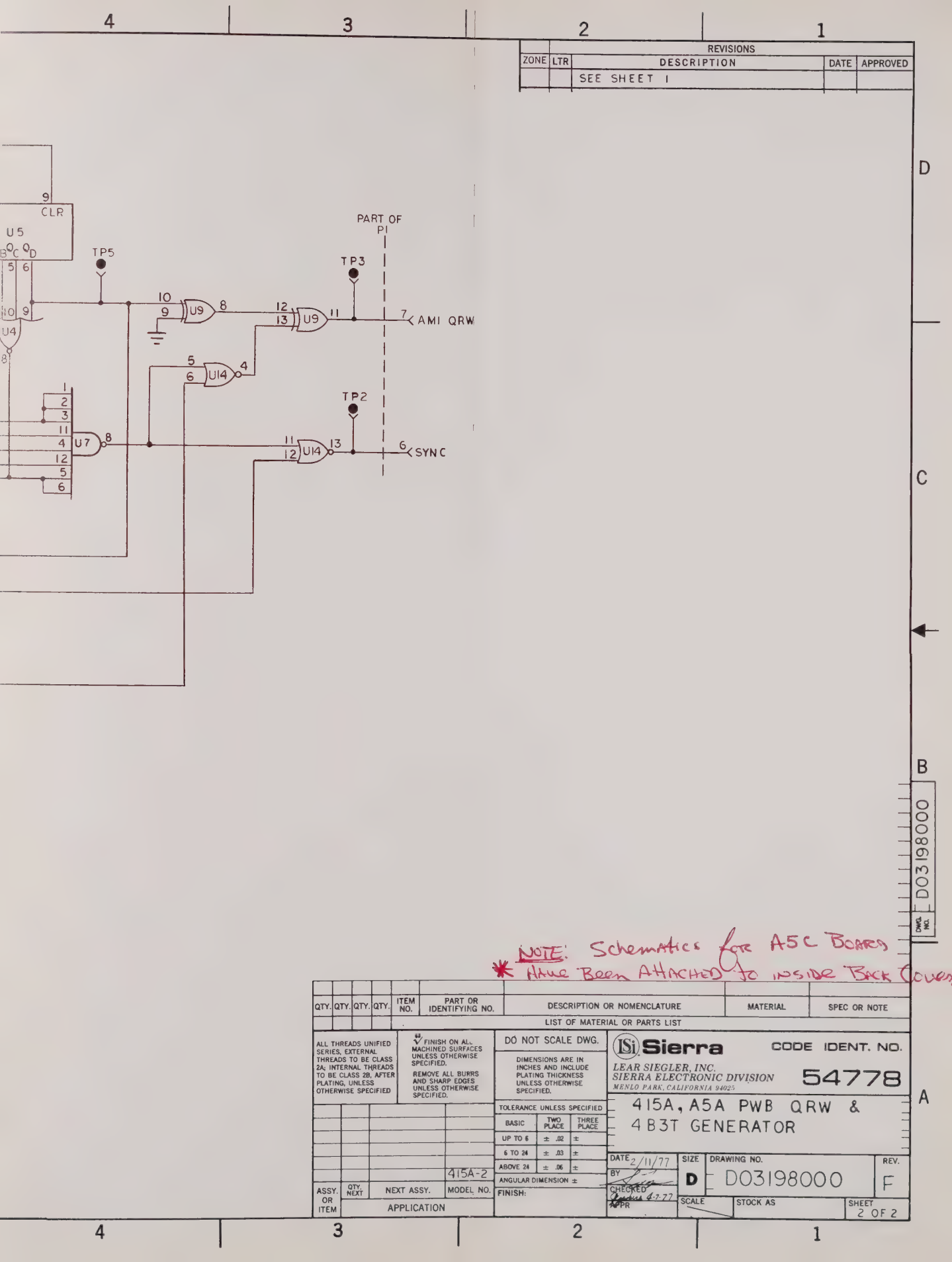
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SEE SHEET 1 B

SPARE CKTS





REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
		SEE SHEET 1	

** NOTE: Schematics for A5C Boards
Have Been ATTACHED to inside Back Cover*

QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE	
LIST OF MATERIAL OR PARTS LIST									
ALL THREADS UNIFIED SERIES. EXTERNAL THREADS TO BE CLASS 2A; INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED.		✓ FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED. REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.		DO NOT SCALE DWG.		Sierra CODE IDENT. NO. 54778			
				DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.		LEAR SIEGLER, INC. SIERRA ELECTRONIC DIVISION MENLO PARK, CALIFORNIA 94025			
				TOLERANCE UNLESS SPECIFIED		415A, A5A PWB QRW & 4 B3T GENERATOR			
				BASIC TWO THREE PLACE		DATE 2/11/77 SIZE D DRAWING NO. D03198000 REV. F			
				UP TO 6 ± .02 ±		BY			
				6 TO 24 ± .03 ±		CHECKED 4-2-77			
				ABOVE 24 ± .06 ±		APPR			
				ANGULAR DIMENSION ±		SCALE STOCK AS SHEET 2 OF 2			
				FINISH:					
ASSY. OR ITEM		QTY. NEXT		NEXT ASSY.		MODEL NO. 415A-2		APPLICATION	

Parts List for 415A-2, A6 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
A6 PCB	Power Board Assembly for 415A-2	A03151900
C1	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C2	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C3	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C4	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C5	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C6	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C7	Capacitor Mica 3 pF .5 pF 500 VDCW	901900030
C8	Capacitor Mica 3 pF .5 pF 500 VDCW	901900030
C9	Capacitor Mica 3 pF .5 pF 500 VDCW	901900030
C10	Capacitor Dipped Mica 8 pF 10% 500V	901900080
C11	Capacitor Dipped Mica 18 pF 5% 500V	901900180
C12	Capacitor Dipped Mica 22 pF 5% 500V	901900220
C13	Capacitor Dipped Mica 33 pF 2% 500V	901900330
C14	Capacitor Dipped Mica 33 pF 2% 500V	901900330
C15	Capacitor Dipped Mica 47 pF 5% 500V	901900470
C16	Capacitor Mica 56 pF 5% 500V	901900560
C17	Capacitor Mica 3 pF .5 pF 500 VDCW	901900030
C18	Capacitor Mica 3 pF .5 pF 500 VDCW	901900030
C19	Capacitor Mica 10 pF 5% 500V	901900100
C20	Capacitor Dipped Mica 33 pF 2% 500V	901900330
C21	Capacitor Dipped Mica 68 pF 2% 500V	901900680
C22	Capacitor Dipped Mica 68 pF 2% 500V	901900680
C23	Capacitor Dipped Mica 68 pF 2% 500V	901900680
C24	Capacitor Dipped Mica 68 pF 2% 500V	901900680
C25	Capacitor Dipped Mica 68 pF 2% 500V	901900680
C26	Capacitor Dipped Mica 68 pF 2% 500V	901900680
C27	Capacitor Mica 10 pF 5% 500V	901900100
C28	Capacitor Dipped Mica 180 pF 2% 500V	901910181
C29	Capacitor Dipped Mica 390 pF 2% 500V	901910391
C30	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C31	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C32	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C33	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C34	Capacitor Tantalum 10 uF 10% 20V	902720106
C35	Capacitor Tantalum 10 uF 10% 20V	902720106
C36	Capacitor Mica 3 pF .5 pF 500 VDCW	901900030
C37	Capacitor Mylar 1.0 uF 2% 100V	901100105
C38	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C39	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C40	Capacitor Dipped Mica 160 pF 1% 500V	901900161
C41	Capacitor Dipped Mica 390 pF 5% 500V	901900391
C42	Capacitor Radial Leads 0.1 uF 10% 100V	901220104
C43	Capacitor Radial Leads 0.1 uF 10% 100V	901220104
C44	Capacitor Radial Leads 0.1 uF 10% 100V	901220104

When given, manufacturer's part numbers are only to aid identification.
Equivalent components from other suppliers may sometimes be substituted.

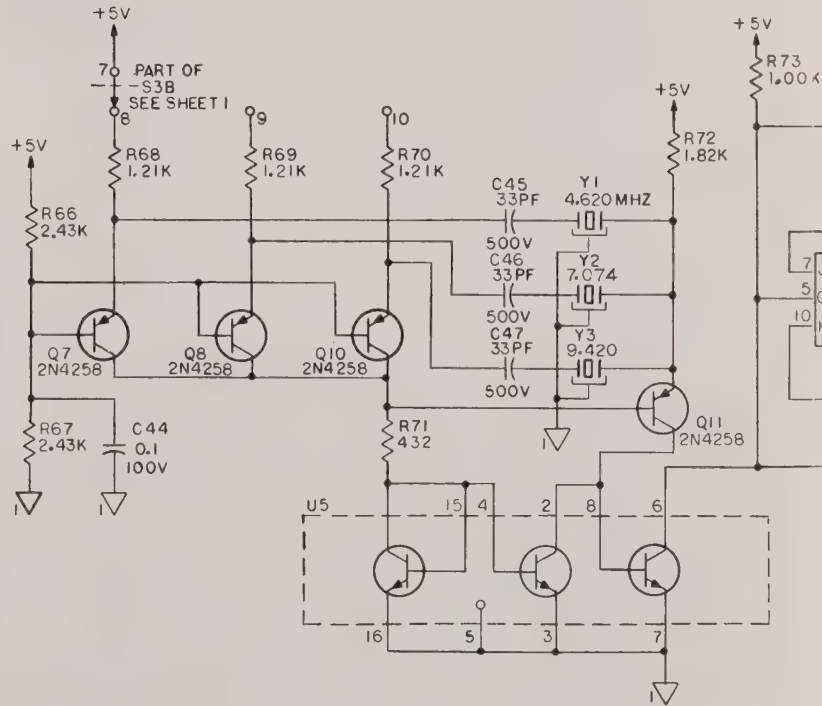
Parts List for 415A-2, A6 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
C45	Capacitor Dipped Mica 33 pF 2% 500V	901900330
C46	Capacitor Dipped Mica 33 pF 2% 500V	901900330
C47	Capacitor Dipped Mica 33 pF 2% 500V	901900330
C48	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C49	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C50	Capacitor Dipped Mica 100 pF 2% 500V	901910101
C51	Capacitor Dipped Mica 220 pF 5% 50V	901900221
C52	Capacitor Dipped Mica 100 pF 2% 500V	901910101
C53	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
C54	Capacitor Radial Leads 0.1 uF 10% 100V	901330104
CR 01	Diode SI 1N4148 75V 150 mA 500 mW	910504148
CR 02	Diode SI 1N4148 75V 150 mA 500 mW	910504148
J1	Connector PC MTG Wafer Assy Polarizing	914800194
J2	Connector PC MTG Wafer Assy Polarizing	914800193
J3	Socket Dip 14 Pin	914200086
L1	Inductor Fixed Molded 160 uH 5% .22W	909000152
L2	Inductor 68 uH 5% .22W	909000136
L3	Inductor 68 uH 5% .22W	909000136
L4	Inductor 68 uH 5% .22W	909000136
L5	Inductor Encapsulated 100 uH Non	909000103
L6	Inductor Fxd 1000 uH 5% 1/4W	909000155
L7	Inductor Encapsulated 100 uH Non	909000103
Q1	Transistor SI 2N3904 NPN	910303904
Q2	Transistor SI 2N3904 NPN	910303904
Q3	Transistor SI 2N3906 PNP	910303906
Q4	Transistor SI 2N3906 PNP	910303906
Q5	Transistor SI PN4258/2N4258 NPN	910304258
Q6	Transistor SI 2N3904 NPN	910303904
Q7	Transistor SI PN4258/2N4258 NPN	910304258
Q8	Transistor SI PN4258/2N4258 NPN	910304258
Q9	Transistor SI 2N3904 NPN	910303904
Q10	Transistor SI PN4258/2N4258 NPN	910304258
Q11	Transistor SI PN4258/2N4258 NPN	910304258
Q12	Transistor SI 2N3904 NPN	910303904
R1	Resistor Metal Film 51.1 Ohm 1% 1/8W	907351R10
R2	Resistor Metal Film 5.11k Ohm 1% 1/8W	907305111
R3	Resistor Metal Film 27.4k Ohm 1% 1/8W	907302742
R4	Resistor Metal Film 27.4k Ohm 1% 1/8W	907302742
R5	Resistor Metal Film 5.23k Ohm 1% 1/8W	907305231
R6	Resistor Metal Film 5.23k Ohm 1% 1/8W	907305231
R7	Resistor Metal Film 5.23k Ohm 1% 1/8W	907305231
R8	Resistor Metal Film 4.99k Ohm 1% 1/8W	907304991
R9	Resistor Metal Film 4.42k Ohm 1% 1/8W	907304421
R10	Resistor Metal Film 1.53k Ohm 1% 1/8W	907304531
R11	Resistor Metal Film 3.83k Ohm 1% 1/8W	907303831

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(SIGNAL)

S4A
REPEATER
TEST
SWITCH



PART OF
J3

13

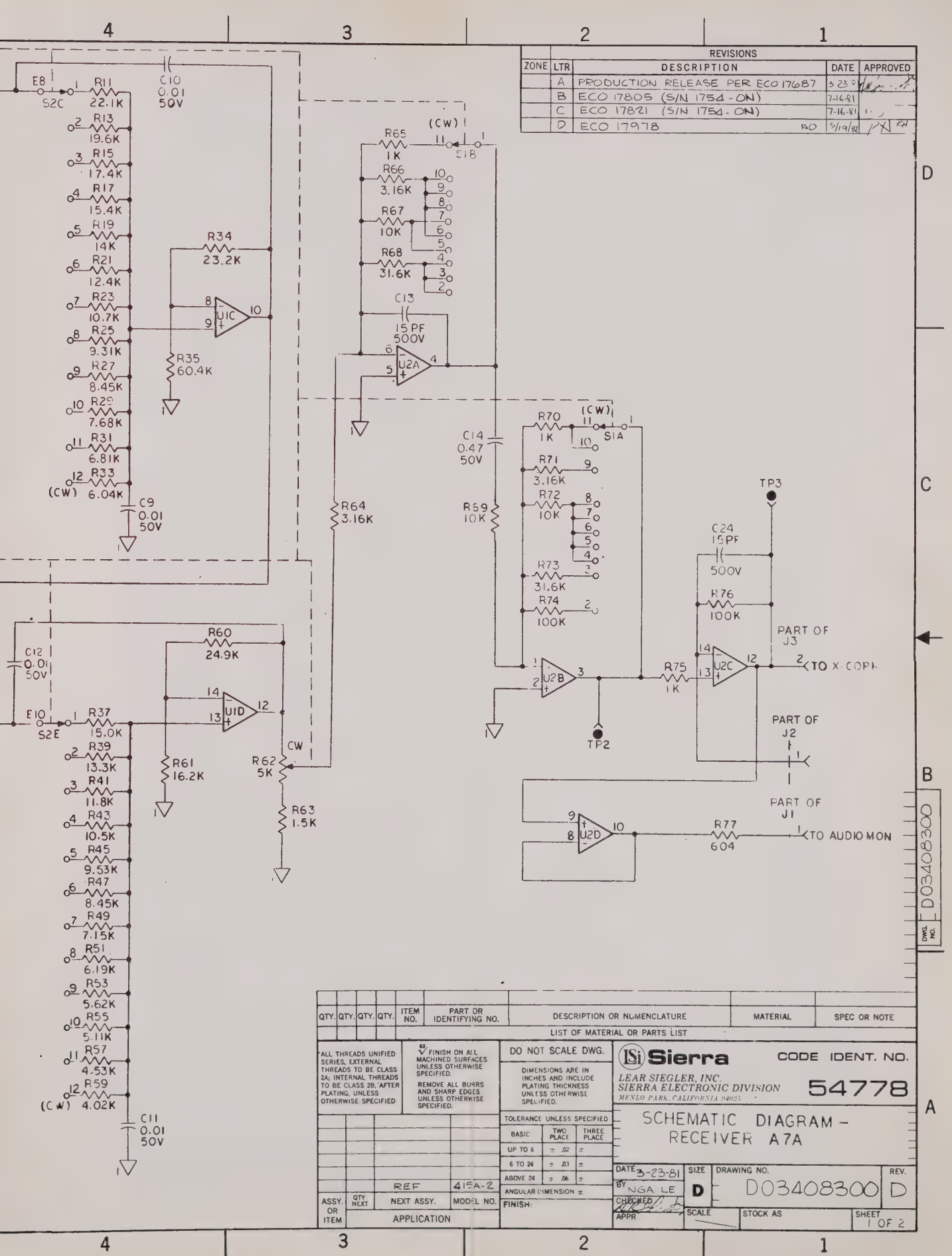
Parts List for 415A-2, A6 Board

REF DESIG	DESCRIPTION	SIERRA PART NUMBER
R102	Resistor Comp 91 Ohm 5% 1/4W	906900910
R103	Resistor Comp 91 Ohm 5% 1/4W	906900910
R115	Resistor Fxd Film 432 Ohm 1% 1/8W	907304320
R116	Resistor Metal Film 49.9 Ohm 1% 1/8W	907349R90
R117	Resistor Metal Film 49.9 Ohm 1% 1/8W	907349R90
R120	Resistor Metal Film 49.9 Ohm 1% 1/8W	907349R90
R121	Resistor Metal Film 49.9 Ohm 1% 1/8W	907349R90
R122	Resistor Metal Film 49.9 Ohm 1% 1/8W	907349R90
R123	Resistor Metal Film 49.9 Ohm 1% 1/8W	907349R90
R124	Potentiometer 10k 10% 15 Turn	907900281
R125	Resistor Metal Film 51.1 Ohm 1% 1/8W	907351R10
S1	Switch 5 Pole 10 Sec	911200264
S2	Switch Rotary S2-A6	911200268
S3	Switch Rotary S3-A6	911200269
S4	Switch 6 Pole 4 Sec	911200270
T1	Transformer Toroidal 6 MH 20% CTI to ICT	909300013
T2	Transformer Toroidal 6 MH 20% CTI to ICT	909300013
T3	Transformer Toroidal 6 MH 20% CTI to ICT	909300013
T4	Transformer Toroidal 6 MH 20% CTI to ICT	909300013
T5	Transformer Toroidal 6 MH 20% CTI to ICT	909300013
U1	IC LM318N Operational Amp	920310318
U2	IC LM318N Operational Amp	920310318
U3	IC LM318N Operational Amp	920310318
U4	IC SN74LS75N Dual J-K Flip-Flop	920317473
U5	IC CA3127E Transistor Array NPN	920303127
U6	IC SN74LS75N Dual J-K Flip-Flop	920317473
U7	IC SN74LS02	920327402
XY1	Clip Crystal Holding Steel	921100004
XY2	Clip Crystal Holding Steel	921100004
XY3	Clip Crystal Holding Steel	921100004
Y1	Crystal 4.620 MHz	912200195
Y2	Crystal 7.074 MHz	912200259
Y3	Crystal 9.420 MHz	912200197

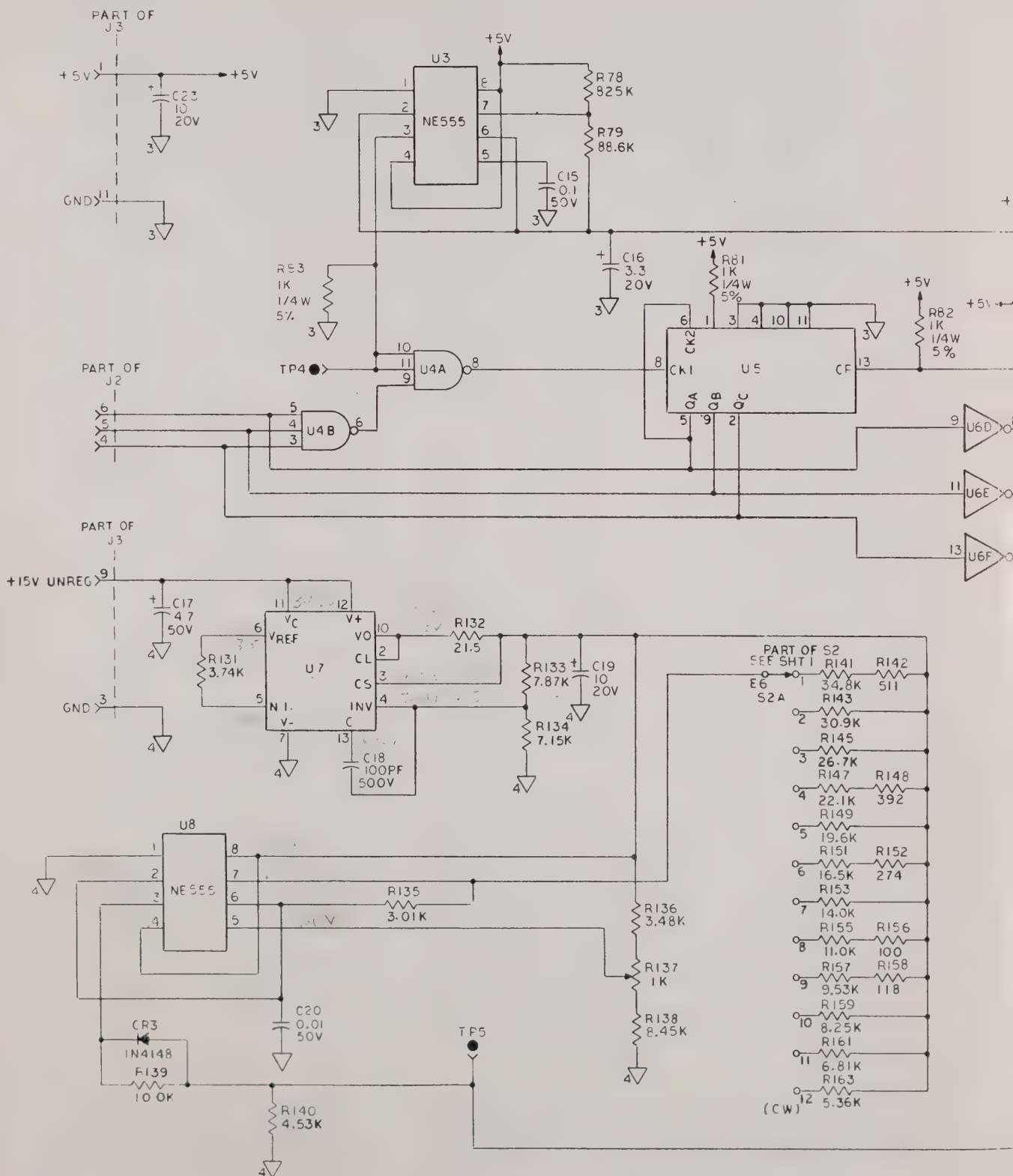
When given, manufacturer's part numbers are only to aid identification.
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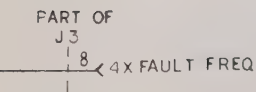
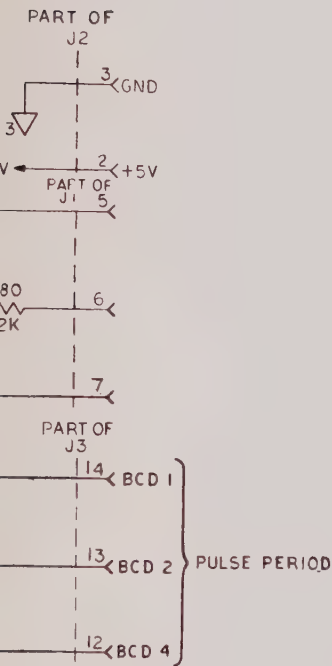
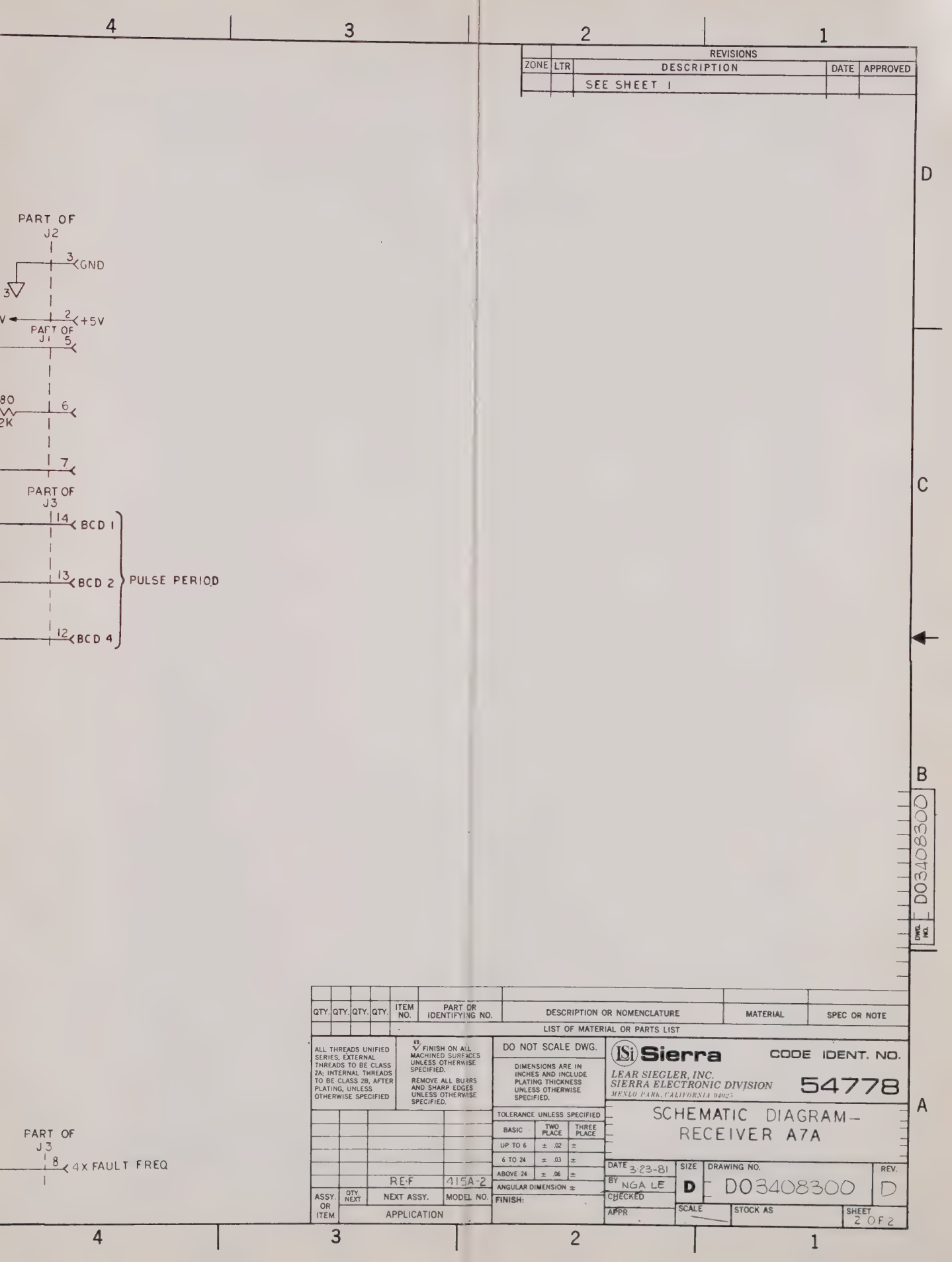
A vertical chart showing resistor values for the R36 to R58 range. The values are listed next to their corresponding resistor designators. The values are: R36 (15.0K), R38 (13.3K), R40 (11.8K), R42 (10.5K), R44 (9.53K), R46 (8.45K), R48 (7.15K), R50 (6.19K), R52 (5.62K), R54 (5.11K), R56 (4.53K), and R58 (4.02K CW). The chart is part of a larger grid with other resistor ranges.

Resistor Designator	Value
R36	15.0K
R38	13.3K
R40	11.8K
R42	10.5K
R44	9.53K
R46	8.45K
R48	7.15K
R50	6.19K
R52	5.62K
R54	5.11K
R56	4.53K
R58	4.02K (CW)



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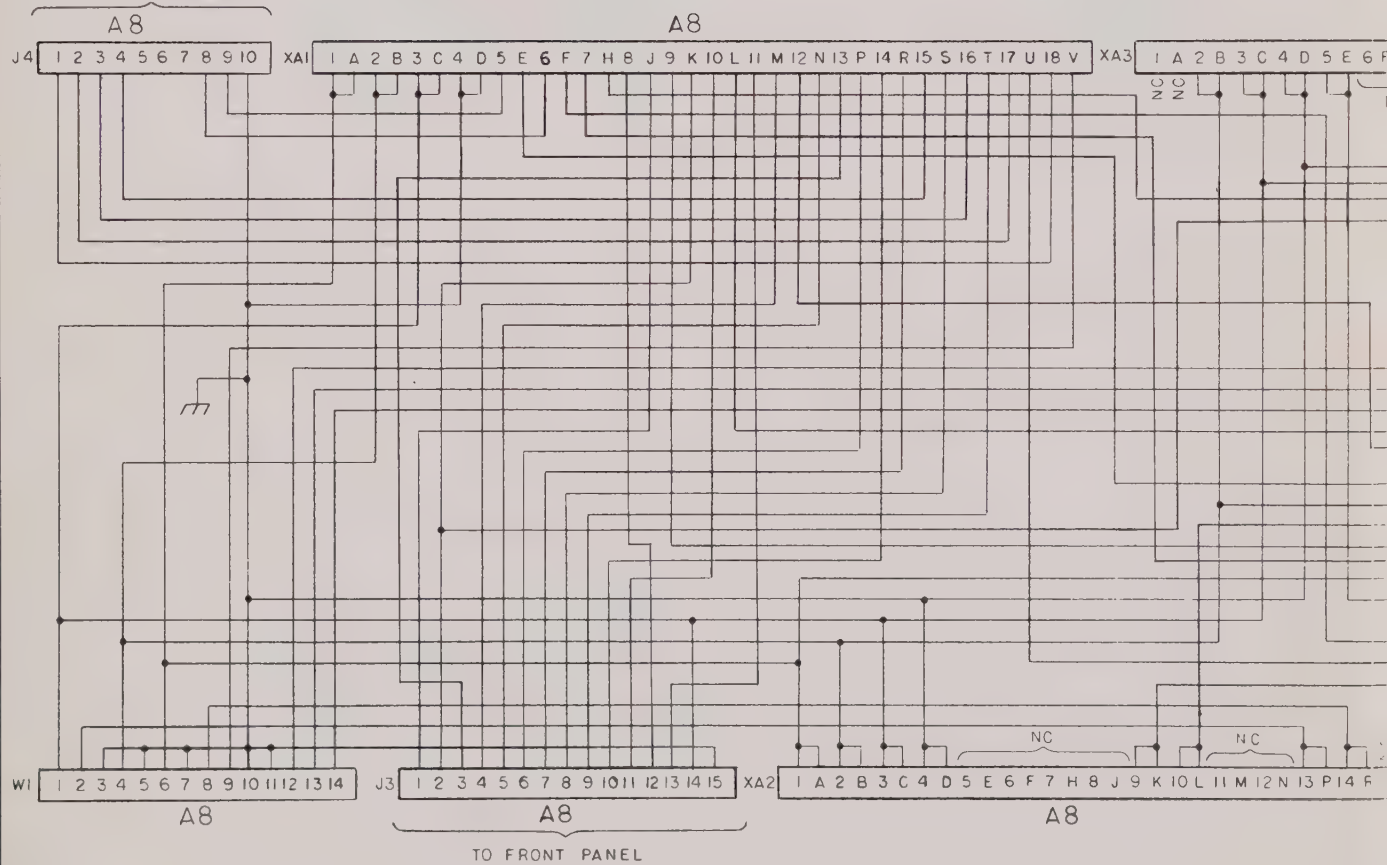




QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
LIST OF MATERIAL OR PARTS LIST								
DO NOT SCALE DWG.						CODE IDENT. NO.		
DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.						54778		
TOLERANCE UNLESS SPECIFIED						SCHEMATIC DIAGRAM- RECEIVER A7A		
BASIC TWO THREE PLACE						DATE 3-23-81 SIZE DRAWING NO.		
UP TO 6 ± .02 ±						BY NGA LE		
6 TO 24 ± .03 ±						CHECKED		
ABOVE 24 ± .06 ±						APPR		
ANGULAR DIMENSION ±						SCALE STOCK AS		
FINISH:						SHEET 2 OF 2		
ASSY. OR ITEM				QTY. NEXT		REF 415A-2		REV.
NEXT ASSY.				MODEL NO.		D03408300		D
APPLICATION								

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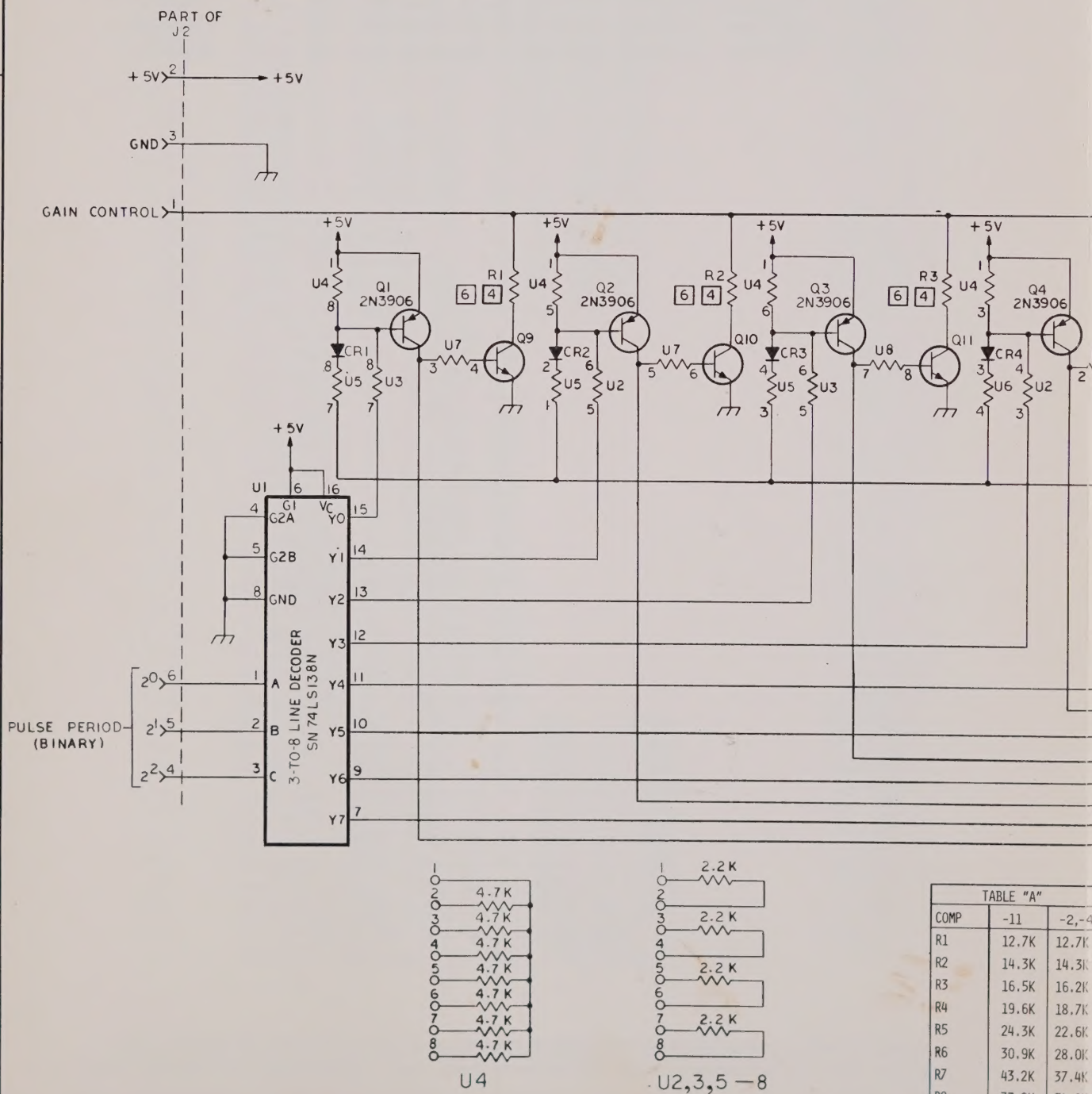
TO POWER TRANSFORMER



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NOTES - UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE VALUES ARE IN OHMS
2. ALL RESISTORS ARE 1/8W, $\pm 1\%$
3. ALL DIODES ARE 1N4148
- 4 SEE TABLE "A"
5. ALL TRANSISTORS ARE 2N3904
- 6 GAIN CONTROL RESISTORS FOR
NON-INVERTING OP AMP



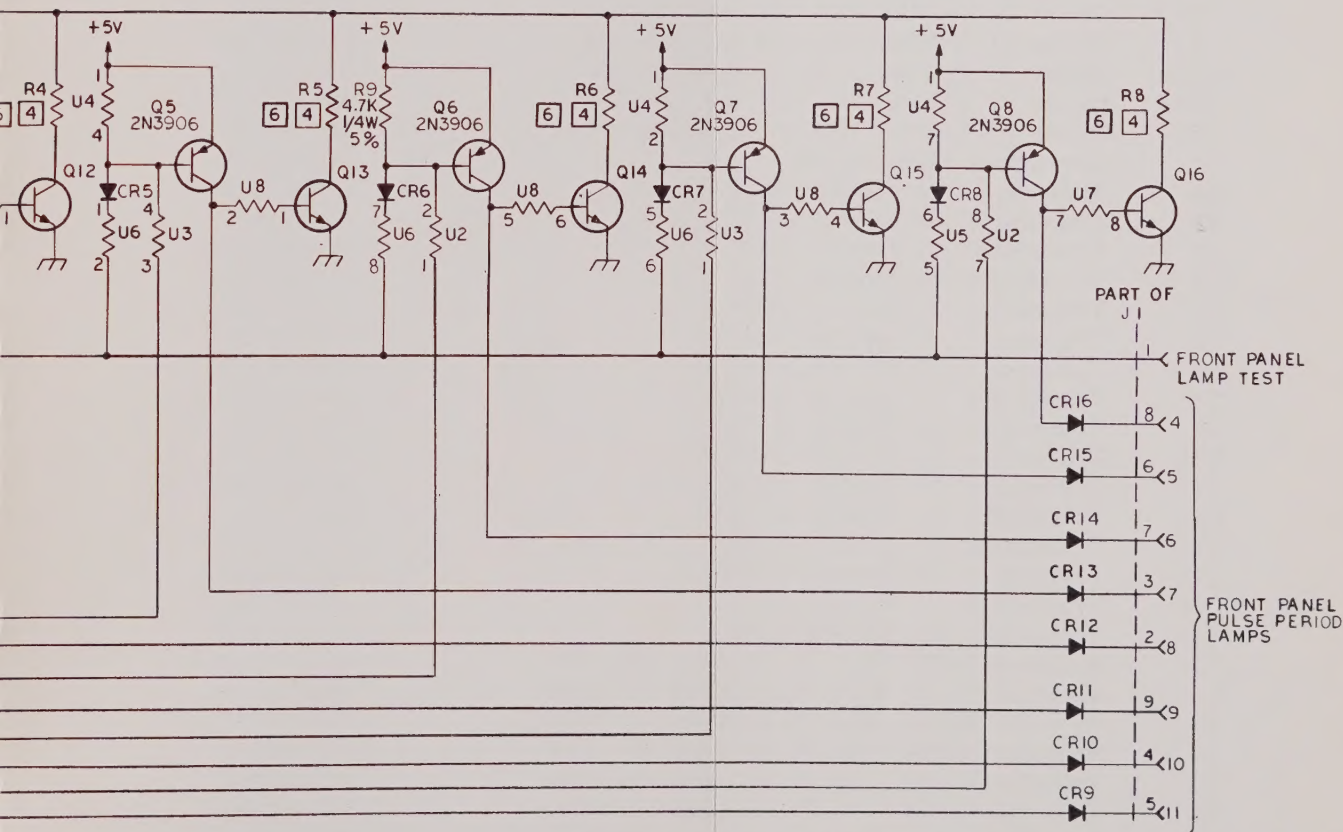
4

3

2

1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	PILOT RUN RELEASE	5/21/76	PAULL
	A2	PC O 1452.1589 RAM	8/17/76	MLD
	B	PREPRODUCTION RELEASE	4/7/77	Sam 20
		PRODUCTION RELEASE	6/7/77	Paul
	B1	ECO 16996	TC 7-20-78	Paul
	C	ECO 17436	5/27/88	Paul



REFERENCE DESIGNATION DATA

LAST USED NOT USED

R9
U8
Q16
CR16

QTY.	QTY.	QTY.	QTY.	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR NOMENCLATURE	MATERIAL	SPEC OR NOTE
LIST OF MATERIAL OR PARTS LIST								
ALL THREADS UNIFIED SERIES, EXTERNAL THREADS TO BE CLASS 2A; INTERNAL THREADS TO BE CLASS 2B, AFTER PLATING, UNLESS OTHERWISE SPECIFIED.					✓ FINISH ON ALL MACHINED SURFACES UNLESS OTHERWISE SPECIFIED. REMOVE ALL BURRS AND SHARP EDGES UNLESS OTHERWISE SPECIFIED.		DO NOT SCALE DWG.	
					DIMENSIONS ARE IN INCHES AND INCLUDE PLATING THICKNESS UNLESS OTHERWISE SPECIFIED.		Sierra LEAR SIEGLER, INC. SIERRA ELECTRONIC DIVISION MENLO PARK, CALIFORNIA 94025	
					TOLERANCE UNLESS SPECIFIED		CODE IDENT. NO.	
					BASIC TWO PLACE THREE PLACE UP TO 6 ± .02 ± 6 TO 24 ± .03 ± ABOVE 24 ± .06 ± ANGULAR DIMENSION ±		54778	
					415A-4 415A-11 415A-2		415A-2,-4,-11 A9 PULSE PERIOD GAIN COMP, LAMP DRIVER	
ASSY. OR ITEM					QTY. NEXT		DATE 2-5-77	
NEXT ASSY.					MODEL NO.		SIZE D	
APPLICATION					FINISH:		DRAWING NO. D03198600	
							REV. C	
							SCALE	
							STOCK AS	
							SHEET 1 OF 1	

D

C

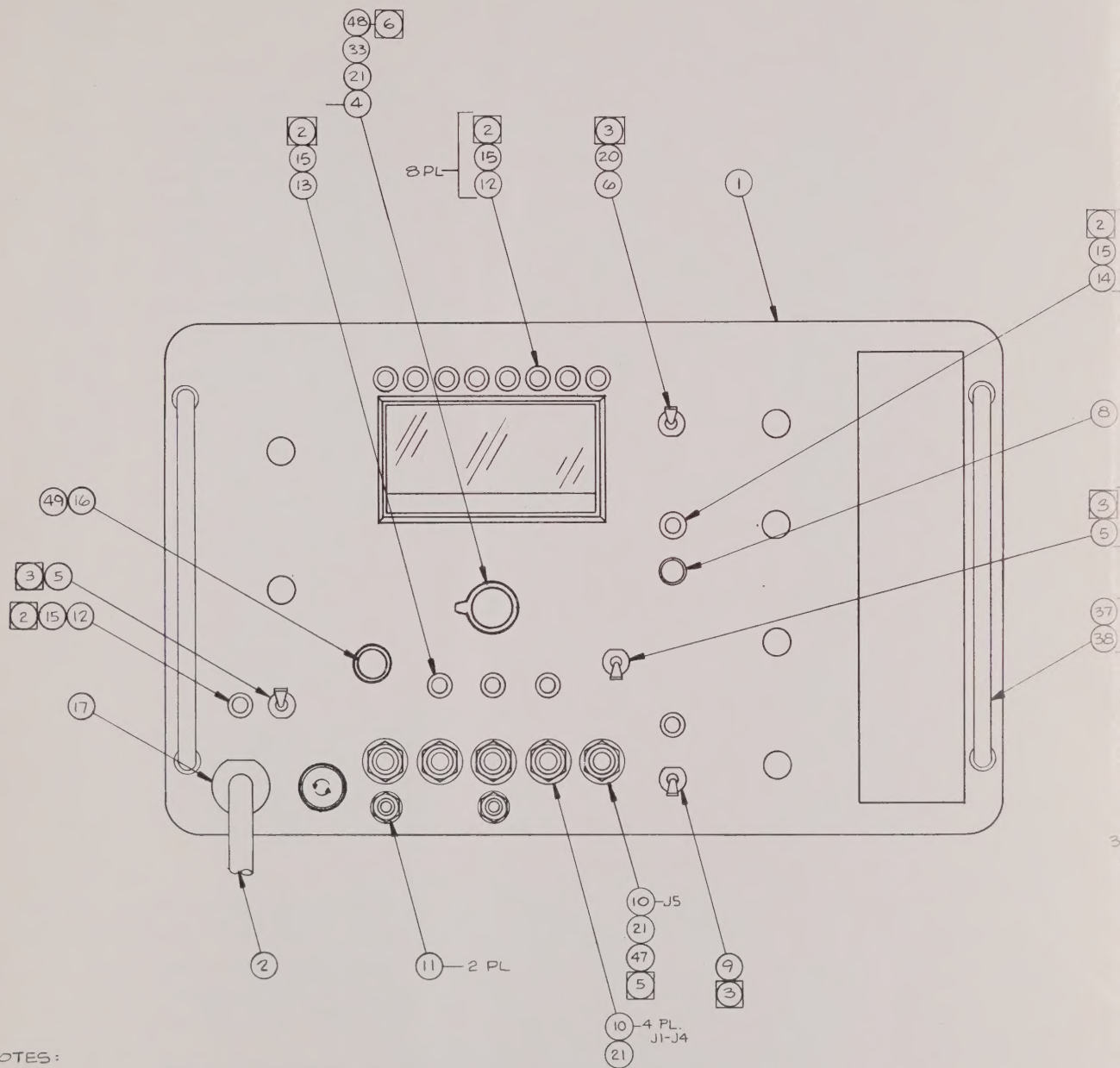
B

A

DWG. NO.

D03198600

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NOTES:

- 1 APPLY VC3 TO BEZEL MOUNTING SCREWS PRIOR TO ASSY.
- 2 INSTALL ITEM 15 AFTER SOLDERING WIRES TO LAMPHOLDERS.
- 3 DISCARD LOCK WASHER SUPPLIED BY VENDOR
- 4 SLEEVE FUSE HOLDER TERMINALS AND ALL TERMINALS OF S6.
- 5 APPLY LOCTITE 416 OR EQUIV. TO THREADS OF J5 ONLY.
- 6 INSTALL KNOB (ITEM 48) AS SHOWN FCCW POSITION.

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